The Chemical Age

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The Recovery of Minerals

THE paper that Dr. W. Cullen and Mr. H. Lavers presented before the Institution of Chemical Engineers on January 15 is a timely reminder of the changes that have occurred within recent years in the practice of purifying minerals, or, as the authors would put it, in the art of separating a mixture of diverse solids so that the more valuable portion is recovered as a concentrate. In froth flotation the solids must be in a finely divided condition so that they can be carried to the surface by attachment of air bubbles, whilst the discarded portion, unlike the concentrate, is wetted by the fluid in which it is suspended and sinks, having no air attachment. Such is the increasing complexity of even the simpler processes, that one day those who specialise in the concentration of metals will not be content to use air, but will further refine their processes by using hydrogen to float certain ores, whilst others, yet more readily floated, will be treated with carbon dioxide. For the present we must, perhaps, be thankful that this complication is spared us.

Froth flotation is comparatively recent in its application to industrial processes. It was only in 1905, judging by a paper read before the Institute of Mining and Metallurgy in 1919 by Mr. H. L. Sulman, that the essential facts upon which modern flotation is based were discovered. Much of the theoretical basis of the process is due to Professor Edser and to Mr. Emil Hatschek. The application of the process has grown considerably since then, and no less than 200 million tons of material are now treated in this fashion annually. Advances in technique have proceeded and have been responsible for this vast increase in quantity of material treated. Formerly the reagents used had a three-fold purpose. First and foremost was the froth-producing reagent, the purpose of which was to extend the air-surface almost indefinitely in the form of minute bubbles throughout a comparatively limited volume of liquid; this gives the selected particles the opportunity of coming into contact with air. The other two types of reagent were used respectively to modify the surfaces of the particles it was desired to recover by rendering them less "wettable" by water and therefore more likely to adhere to the air bubbles and to float when brought into contact with an air-bubble system; and to increase the adhesion for water of the particles it was desired to reject by decreasing their interfacial tension and so rendering them more easily wettable, and therefore more " sinkable." It is now necessary to divide the reagents into collectors, frothing agents, gangue modifying agents, and depressant and activating agents. The introduction of frothing agents has eliminated all previous methods owing to the large increase in the liquid-air surface, if only because a froth several inches deep has a vastly greater mineral carrying capacity than a single film covering the same horizontal area.

The authors mention the application of flotation methods to coal cleaning, and coal may be used to exemplify the increasing complexity of modern methods of cleaning minerals. Not so many years ago no colliery would have entertained any method of cleaning coal other than the float-and-sink method that had grown up over many years from the middle of the last century and in which the coal was washed by being jigged up and down in a current of flowing water. The fine coal and shale, the " slurry," occasioned no little difficulty, but for long no attempt was made to avoid the trouble. About 20 years ago a start was made in this direction by passing the smaller sizes of coal over rapidly vibrating screens of fine mesh, but the practice did not become general, largely because it was not applicable to wet coals and because the screens developed holes repeatedly. The next attempt was to remove the dust by a current of air. A variety of modifications of this method exist and appear to operate with an extraction efficiency of some 80 to 90 per cent. These methods are being reinforced by elaborate chemical clarification of the washery water.

In a few—a very few—British collieries the fines are cleaned, sometimes after crushing, by flotation, either under pressure or under a vacuum; yet another chemical process has thus been added to the coal-cleaning operation. A whole range of processes has sprung up in which the attempt is made to clean the coal more efficiently by the use of solutions heavier than water, the additional density being obtained by calcium chloride or by the suspension of sand or of barytes in the water whilst the effluent water is clarified by Dorr thickeners and similar plant. Another range of processes is that of dry-cleaning, in which water is not used. Almost every possible physical property of the coal and of the dirt has been used for this purpose—the angle of slip, the relative resiliency of coal and stone, the relative weight of coal and stone in an upward current of air, gaseous elasticity and the velocity of projection of coal and stone over a gap, are the more important of these methods. It is evident that, even if we exclude the purely chemical methods of concentrating any particular constituent of the minerological complex that is to be treated, there is available to-day a remarkable variety of physical processes which can be applied to the art of ore concentration, many of which have not yet been the subject of a complete investigation.

Notes and Comments

The Chemical Engineering Congress

THIRTEEN countries are participating officially in the Chemical Engineering Congress of the World Power Conference which is to be held at the Central Hall, Westminster, from June 22 to 27. No fewer than 116 papers are to be presented, of which Great Britain will be responsible for 32, Germany for 18, the United States for 16, and Japan for 12. The provisional time table and list of papers just issued shows that the congress will be offically opened on the Monday afternoon and will continue, with only one free evening, until the Saturday morning. The business of the congress is conveniently divided into twelve sections, dealing respectively with ferrous metals, refractories, rubber, plastics and other materials in plant construction; separation; size reduction, grading and mixing, electrolysis and electrical applications; destructive distillation; treatment and disposal of effluents and waste materials; lubrication; high pressure reactions and high vacua; heat exchange; education and training, statistics, administration, safety and welfare; trend of development; and general aspects. Organisations in Great Britain are presenting papers in every section. The organising committee will appoint a general reporter for each section of the congress; the general reporters will prepare reports reviewing the papers submitted under each heading of the congress programme and will direct the attention of the meeting to those aspects of the subject to which it is felt discussion could be most usefully directed. The congress is the first of its kind to be held under the auspices of the World Power Conference and it is anticipated that a large number of chemical engineers from all parts of the world will assemble in London for the occasion.

The Plant Exhibition

THE Chemical Engineering Congress will be international in character, but the chemical plant exhibition to held simultaneously on other floors of the same building by the British Chemical Plant Manufacturers' Association will be confined to British plant. A unique opportunity will be presented to the British plant manufacturer to show the world that he is capable of producing plant second to none, and from the response that has already been received to the invitation to apply for stand space it is evident that the opportunity is not going to be neglected. Only two such exhibitions have previously been held in this country, one in 1926 and the other in 1931. So great has been the progress in chemical engineering since that time that it may be expected that quite a large proportion of the plant on exhibition will be entirely new. The exhibition is the plant makers' answer to the criticism often raised that they do not exhibit their wares sufficiently. We have heard it argued many times that there should be a chemical plant section at the British Industries Fair, but the industry itself has quite definitely adhered to the view that a display at longer intervals in conjunction with some special chemical or chemical engineering gathering produces the best results. A number of chemical plant makers show regularly at the Birmingham section of the British Industries Fair, but these invariably have considerable interests outside the strict conception of chemical plant and it is on account of those interests that they generally exhibit.

Platinum Industry in 1935

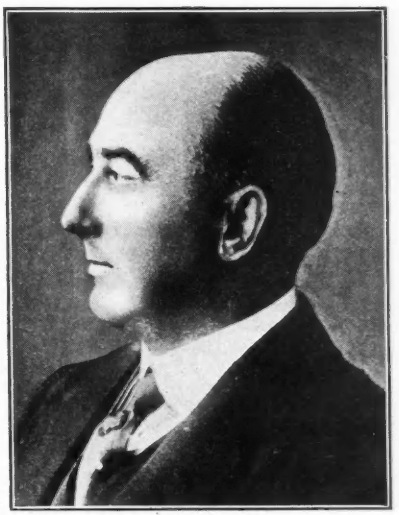
CONSUMPTION of the platinum metals in 1935 confirmed the revival of all the industries in which they are used. Developments in the latter part of the year were particularly significant. Canada continued as the leading producer, being followed in order by Russia, South America and South Africa. Consumption of all platinum metals, including palladium, was close on 275,000 ounces. The continued activity of the chemical industry led to several new developments and to further inquiry for platinum catalysts and laboratory equipment. Platinum-clad material for chemical apparatus is again being discussed in the industry. This follows closely the introduction of nickel and other clad materials. There appears to be no reason why industry should not avail itself of the corrosion-resistant properties of platinum in this economical form. In dentistry the use of platinum and palladium alloys continues to grow. To the æsthetic advantages of their neutral colour are added the sanitary considerations that they make for surfaces which are non-tarnishing and easy to clean. In addition careful consideration by members of the dental profession of the qualities of precious metals has led to a further appreciation of the properties of platinum and palladium and their alloys. Industrial uses of platinum metals continue to advance or to hold their own. Among those in which platinum has become well established are the rayon manufacturing industry, which uses platinum gold spinnerets for handling caustics, and the electrical field, where platinum points in magnetos provide a high degree of reliability for aeroplane motors and similar apparatus.

Search for an Adjective

MEMBERS of the Society of Dyers and Colourists are co-operating with representatives of textile manufacturers, wholesalers and retailers in an endeavour to find an alternative to the word " fadeless " as a description for textiles. It is generally agreed that the obsolete term " fadeless " is inapplicable to a relative quality. It has been the subject of such abuse that standardisation of colour fastness and guarantees are urgently required in the trade. Generally the wholesale and manufacturing interests are in favour of the complete abolition of the word " fadeless," but the retailers are opposed to this step on the ground that the consumer has become accustomed to the term and that it represents a good deal of selling value. Even the shopkeeper admits, however, that the abuse of the term by some suppliers often results in much trouble. It is clear, therefore, that some more satisfactory term is needed. As the outcome of a meeting convened by the Retail Trading Standards Association a working sub-committee is to be set up to study the question. On the furnishing side of the textile industry it is felt that " fadeless " and all its synonyms should be abolished, and goods should be guaranteed as being of " approved fast dyes " or such other term as might be suitable for use between retailer and customer.

I.C.I. Before the Arms Commission

Sir Harry McGowan Denies that the Company is Essentially an Armaments Firm



Sir Harry McGowan, Chairman of Imperial Chemical Industries.

SIR HARRY McGOWAN, chairman of Imperial Chemical Industries, Ltd., gave evidence before the Royal Commission on the Private Manufacture of and Trading in Arms on Wednesday. He submitted that the printed outline of the company's evidence which had been placed before the Commission disproved once and for all the widespread fallacy that the company was essentially an armament firm. The exact contrary was the case; munitions represented 1.4 per cent. of the total profits of the company. Its interests, therefore, obviously lay in the largest measure in products outside the definition of armaments; and for the prosperity of the company he desired nothing more than a state of tranquillity in order that it might continue to expand its peace time industries. Their munitions manufacture, small as it was, was conducted with the full knowledge of the Government Departments concerned.

Direct charges against the company during the inquiry had been few; indeed, in the case of one or two witnesses, the company had been complimented on its efficiency. Other witnesses had suggested that there was something, always undefined, which if they would only search long enough they would find to support the allegations which had been made. The company was prepared to deal with all or any of these matters, however trivial or even ridiculous.

The "Non-Existent" Agreements

The Commission had been asked to call for agreements contained in a list, which it was alleged was a list of representative documents. There were cited 38 such documents. The facts were that of these 38, 18 were non-existent as agreements. Of these 18, four referred to investments in explosives companies, but only one of these investments was in a company which made military as well as industrial explosives, and that was in Czechoslovakia. Of the remaining 20 agreements, four only had any reference to munitions. He resented the suggestion that the company or any individuals connected with it were actuated by base motives in supplying such materials as friendly nations, often unequipped with their own factories, needed. Such supplies were only made with the full knowledge of the British Government, and only under British Government licences. The company had never done anything to hinder the British or any other Government's efforts for universal peace, or suggested to any foreign government that they should buy more than they themselves thought they needed.

It was to be expected that those whose political faith led them to believe that the socialisation of all industry would be for the benefit of the nation, should seek to discredit the part which private industry played in the last war. He did not question the sincerity of those who held that view, but it was misleading to suggest that private industry failed the country in the war. That mistakes were made, that miscalculations as to quantities required and available at a given time, took place, and that developments were unforeseen, or not fully anticipated, must be admitted by everybody. Such mistakes and miscalculations were common to the Services, politicians, State-controlled factories and private enterprise. The demands made on private industry were peculiar and colossal, and it was from private industry that the Ministry of Munitions was mainly recruited. The companies now associated in Imperial Chemical Industries, Ltd., lived up to their promises, and the thanks accorded them for their efforts was fairly earned.

Although the inquiry was limited to a defined range of products, there were many substances produced by the chemical industry of great importance in peace time, and a great deal of machinery used in their production, which, if the nation was involved in war, were of vital importance. He wanted to assume, solely for the sake of argument, that the Government of the day proposed to enter chemical industry. It would be quite unreasonable for the Government to select this industry for a State monopoly while other industries, equally essential in times of emergency, were allowed to maintain their private status. Logically, the Government must select all or none. Another difficulty, even more fundamental, was the problem of export trade. Let them imagine for one moment that the Government was in control of chemical industry. In other countries, where private enterprise still remained, the traders in those countries would be competing for the world markets. One of their competitors would be the British Government, who in peace time would have to sell the products of British chemical industry in all parts of the world against the private traders in foreign countries. Such complications must inevitably embarrass any government when entering into those commercial treaties with foreign countries which had become part of the Government's policy.

Nationalising the Chemical Industry

The Commission had had evidence, designed to show the practicability of the prohibition of the private manufacture of and trading in chemicals and explosives, and the institution of a State monopoly. In his view none of this evidence showed any real understanding of the problems of chemical and explosives manufacture, but appeared to be based on printed formulæ and published processes. Supposing, again solely for the sake of argument, they ignored the huge capital cost of nationalising the chemical industry, and the many years of practical experience gained by those engaged in the industry, they were still faced with the problem of personnel.

It had been truly said that business men during the last war threw themselves wholeheartedly into the service of the State. From that it was assumed that in peace time, if the State assumed control of chemical industry, or any part of it, executive and technical men who had been successful in commercial life would necessarily be willing to throw in their lot with a State monopoly. This he believed to be a complete fallacy. The industrialists of this country had had handed down to them generations of experience which had been expended in establishing private enterprise on a solid foundation. To them, the incentive of commercial

rivalry had led to high standards of efficiency. To remove that commercial rivalry in times of peace would leave them without the mainspring of their actions and would leave the country in time of war with less efficient manufacturing units.

Sir Harry McGowan said he did not wish to criticise those persons who were desirous, in their own words, of "taking the profit out of war," by which he supposed they meant making profiteering in war requirements impossible. If one looked at the list of munitions which the Commission was considering, one could not help being struck by the variety in character. The production of the items cited involved many differences in the capital employed, research expenses, wages, materials and explosion risk. Therefore, it did not seem to him that it would be possible to evolve one simple scheme to control the profit on all those items.

Profiteering in War Requirements

With regard to export trade in munitions, this business could only be taken subject to the Government allowing such export, and had to be secured in the face of international competition. If and when this approval was given, it was the duty of every British industrialist to strive to obtain a fair share of that business in order that the British industry might remain established in this country, to find employment for our people and to keep in action plant and personnel essential to national security. The present system of export licences was useful. It enabled the Government to be satisfied that orders placed with British manufacturers by foreign countries might be safely executed. No other system provided better safeguards. It seemed to him that if this system of licences was not maintained, the only choice which apparently remained was between the abolition of exports altogether or the British Government and other Governments would themselves have to undertake the supply of arms to friendly nations.

Regarding the total prohibition of all exports of munitions, this must inevitably lead to each nation setting up its own munition factory. In this way increased capacity for production would result, and the maintenance of that plant in working condition might lead to production in excess of defensive requirements. If the anticipating of emergency requirements involved the building of further State factories ready for operation if and when unfortunately the need arose, he suggested that in normal conditions the Government should continue to place orders with private industry to encourage the maintenance of manufacturing experience. Industry should be encouraged to continue research, and the developments arising out of such research should be proceeded with in order that when the industries of the country had to be mobilised in time of crisis, the results of this work might be at the disposal of the Government. It was perhaps unnecessary to add, in view of the past record of I.C.I., that if such a plan were adopted, they would willingly throw the whole weight of their resources, as they had always done, in assisting the Government.

A Permanent Supervisory Body

Sir Harry suggested that there should be established at once a permanent supervisory body which would have to be armed with full powers and which would, with due financial safeguards, co-ordinate private manufacture and provide such auxiliary help as might be necessary where the demand was likely to be in excess of the capacity of private concerns. If this suggestion were adopted, the procedure would be that the Government would make a complete survey of the capacity of governmental and industrial concerns, and, after that survey, the Government would then decide what policy should be adopted. The supervisory board would be required periodically to take a census of production and would have to work out plans for ensuring all necessary supplies. It would have to see that adequate stocks were available, and that transport and all other services, including personnel, could be provided at short notice. It would, in fact, be responsible for doing the work which in the last war was done by the Ministry of Munitions. Its function would be to encourage industry to co-operate in the fullest possible manner with the Government.

At the conclusion of his speech, Sir Harry McGowan was questioned by several members of the Commission with regard to the supply of explosives to China, South America and other parts of the world. The Commission adjourned until Thursday, when Sir Harry McGowan and his colleagues gave further evidence.

Flotation as Applied to the Chemical Industry

Institute of Chemical Engineers Discuss Dr. Cullen's Paper

AT the conclusion of his paper on "Flotation as Applied to the Chemical Industry," read before the Institution of Chemical Engineers on January 15 and reported in THE CHEMICAL AGE, January 25, 1936 (page 73), Dr. W. Cullen said he did not wish to give the impression that flotation could accomplish everything, because it could not. Flotation had been tried at the Cornish tin mines and it had been a hopeless failure so far as tin was concerned. But selective flotation had removed mispickel, pyrites and other sulphides which were nothing less than a nuisance. By flotation they could be separated, leaving a comparatively clean SnO_2 which could be sent direct to the smelter.

Mr. W. RUSSELL, who had seen the flotation process applied to many ores, said that before it was applied to the coppery ores the maximum extraction was from 66 to 67 per cent., whereas nowadays the extraction is more than 90 per cent. Thus, lower-grade ores could be handled than was the case formerly, or a great deal more copper could be obtained from the same ore than was obtained formerly. That was perhaps one of the reasons for the present low prices of copper; the purchaser is buying copper at £35 per ton to-day, whereas 25 years ago the figure of £55 per ton was the minimum that would secure the production of sufficient copper to satisfy the demands of the market. The public throughout the world had benefited by the process and it was difficult to say by how much the wealth of the world had been increased as the result of the application of the flotation process to copper.

The same remarks applied to the production of lead and zinc. About 15 years ago several high authorities had been very much exercised in their minds concerning future supplies of lead and zinc, and had felt sure that there would be a famine and that the prices would rise. But selective flotation had raised the grade of the concentrate and had raised the efficiency of recovery, so that duffs that formerly were wasted were now being treated and very good marketable products were produced from them. In view of the fact that the concentrate itself was improved, the lead being more free from zinc, there were not the troubles that formerly occurred in smelting.

Discussing the application of flotation to products other than metals, Mr. Russell pointed out that quite a number of plants were treating low-grade phosphate rock and improving its grade in order to make the right superphosphates. In Florida it was being applied to a large quantity of material which formerly was known as debris. Some of the mines were almost exhausted before the introduction of the process, but they are making more out of the debris to-day than they

were formerly making out of the original ore. In one case it had added 15 years to the life of the mine. Another advantage was that the producers could mine straight away, whereas formerly they had to mine selectively.

Another matter which Mr. Russell referred to was the treatment of cement rock by flotation. This process, he said, had been introduced within the last year or two and should make a great difference to cement producers working on low-grade lime rocks. In Valley Forge, Pennsylvania, there was a rock which had almost the natural composition of cement. The lime content, however, was a little low and formerly it had been found necessary to mine selectively in order to maintain the lime content of the rock as mined to a certain figure. But fairly recently the flotation process had been applied, and they used oleic acid. The producers of the present time were able to mine straight ahead. The material was put into the wet mill, the wet slurry was analysed and, if the lime content were found to be low, a certain proportion of the slurry went to the flotation plant. The material there was de-slimed, as in the case of the phosphate rock, and the granular portion was floated and it needed no further grinding, being fine enough.

Empirical Knowledge

Professor B. W. HOLMAN said that our knowledge of flotation was still empirical, in spite of the vast amount of experimental and practical work that had been done. The theory of the subject was in a rather muddled state. He had known cases in which materials which had been left over from stores had been put into the flotation plant in order to see what happened. For example, when a lubricating oil had not proved very successful as such, and its use had resulted in the failure of a big end, it had been put into the flotation circuit. In one case some carbolic soap had been given to the miners for the purpose of washing themselves, but they had objected to being asked to wash themselves with carbolic soap; the soap was then put into the flotation circuit. The plant was operating in a very cold climate, and to the surprise of those responsible it was found that a good deal more froth was obtained, together with the recovery of a higher-grade material of a quantity equal to that obtained previously. On investigation, it was found that that result was due to the rhodamine used as a colouring matter in the soap; this had the property of depressing talc, and the increased grade was due to the absence of the talc from the ore. So that the new reagent, Rhodamine B, which had been put on the market for depressing talc, was arrived at about a year ago by that rather excellent practice of ignoring theory and going in for experiment.

The Cleaning of Coal Slurry

As to the cleaning of coal slurry, which the authors had said had not met with the attention it deserved, largely owing to the difficulties experienced in handling the cleaned coal, Professor Holman said he believed the chief difficulty in handling it was that of drying it. The flotation process was operated in a number of collieries, but the reason why some collieries were so genuinely enthusiastic about the process was that as the result of its use they were able to briquette their fine coal. The fine coking constituents of the coal floated more readily in some cases than did the non-coking constituents, so that the collieries were able to produce a briquette of higher quality than the run-of-mine coal; they did not need to dry the coal before briquetting. Where a colliery could produce a briquette of higher quality than the run-of-mine coal, the flotation process was an unqualified success.

Mr. H. M. RIDGE said one might fairly expect that the application of the process to the straight chemical industries would increase in the future, though possibly at not quite the same tonnage rate as in the mining industries. Coal was a substance of great concern to all in this country, and the application of the flotation process to the treatment of coal was of the greatest importance. The process would be of interest to an industry such as that of low-temperature carbonisation. If the coal supplied to that process were first treated by the flotation plant, the ash content of the resulting product, naturally, would be dead low, and that product would have even better combustion qualities in the household grate than would other similar products on the market.

Another outstanding feature of the application of the process, said Mr. Ridge, was in connection with blast furnace operation. The amount of coke fed into the normal blast furnace per 24 hours was large, of course, and when the coke contained, say, 12 or 15 per cent. of ash—and ash contained not only silica but also a considerable proportion of alumina—the amount of additional materials that must be added in the blast furnace to slag off the alumina became quite an important consideration. If one could eliminate the alumina from the coke fed to blast furnaces, quite a good saving of cost would be effected and the cost of producing the pig iron would be reduced.

An Unexplained Phenomenon

Dr. A. J. V. UNDERWOOD, referring to figures showing the influence of the metal of the flotation machine in the recovery of zinc blende, pointed out that when the body of the machine was made of copper and the impeller was made of iron, the results obtained were very different from those obtained when the body of the machine was made of iron and the impeller was made of copper. That was also evidenced in items where in the one case the body was of copper and the impeller of zinc, whereas in the other case the body was of zinc and the impeller of copper. If it were a case of the metal going into the solution, one would rather expect to obtain the same results when using the same two metals, except that the relative areas exposed to the action of the materials processed might be very different.

Mr. W. A. DAMON, dealing with the reference in the paper to the efficiency of the xanthates of the higher alcohols in promoting the flotation of one sulphide in preference to another, wondered whether there was a very great difference between the efficiency of the xanthates of the higher alcohols, and that of the xanthates of the lower alcohols, such as sodium-methyl-xanthates. Quite a quantity of crude sodium-methyl-xanthate was available in this country, arising from the purification of benzol from sulphur by the xanthate method. In spite of a remark that the flotation process was hopeless in regard to the concentration of tin, Mr. Damon expressed the hope that attempts to achieve success in that direction had not yet been abandoned entirely. The methods used for concentrating tin ores in Cornwall at present were, to say the least, rather crude in most cases and any improvement of these methods that could be applied might enable the tin industry to regain the prosperity it once enjoyed.

Dr. CULLEN, dealing with the remarks of Mr. Russell and Mr. Ridge, concerning the present costs of metals, said we were rather apt to overlook the great metallurgical achievements of this country; the reduction of the price of copper and the fact that a small profit could be made at the lower price, represented a remarkable achievement. Another very important fact which it was well to bear in mind was that the consumption of metals of all kinds since the beginning of the present century had been greater than the consumption throughout the whole history of the world prior to the present century. In other words, we were using our mineral resources at a tremendous rate, and the process would have been accelerated to a disastrous extent but for the introduction of flotation processes.

Omission of Name of Pioneer Inventor

Mr. E. KILBURN SCOTT expressed astonishment that the paper had not made reference to the important early work of Elmore in connection with flotation. He suggested that an International Committee of scientists—men with common sense, and no lawyers—might be formed to ensure that credit was given to the pioneer inventors to whom it was due.

Dr. CULLEN agreed that the omission of Elmore's name must be remedied before the paper was published in the Institution's Proceedings.

Analytical and Research Chemicals

A Range of I.C.I. Manufactures Conforming to Various Standards

IT is possible that the wide range of pure chemicals for analytical research and medical purposes produced by the various manufacturing groups under Imperial Chemical Industries, Ltd., tends to be overlooked among the more generally important and better-known standard heavy chemicals. Whilst a number of these standard lines are themselves put up in grades of the highest purity commercially attainable, there are many other products, organic and inorganic, with more specialised applications, and which are marketed as fine chemicals, including some laboratory reagents and medicinal chemicals of first importance.

Inorganic Products and Reagents

Among the standard heavy lines which are put up in grades of specified purity are the common mineral acids, which are all made to conform to both B.P. and reagent standards. Hydrochloric acid of reagent quality, and suitably diluted to the requirements of the 1932 British Pharmacopoeia, is marketed 32 and 36 per cent. strength, the maximum limits of whose permitted impurities only very slightly exceed a total of 0.0023 per cent.

Sulphuric acid which conforms to the requirements of the 1932 British Pharmacopoeia, as well as to the more stringent standards for reagent quality, is also put up in glass-stoppered carboys and winchesters. The lead limit prescribed for "acidum sulphuricum" of the Pharmacopoeia is 20 parts per million, and the acid must leave on ignition not more than 0.01 per cent. of solid residue. Specifications for reagent quality acid call for a 98 per cent. sulphuric acid with an inappreciable quantity of non-volatile matter, giving no reaction for selenium, and an arsenic content (calculated on As_2O_3) of not more than 0.00001 per cent. In addition to these two grades, a pure sulphuric acid (either concentrated or diluted ready for use) is specially produced for use in accumulators. The concentrated acid is a water-white, specially pure form of R.O.V., which easily complies with any of the leading specifications for battery acid. Among these may be mentioned the Post Office specification, which requires the acid to be colourless when viewed through 12 in. of the medium, whilst the maximum permissible residue on evaporation of 100 c.c., of sp. gr. 1.215, is 0.05 gm. Copper, arsenic, sulphurous acid, and nitrogen and chlorine in any form are limited to 0.001 gm. in 100 c.c.

Sodium Compounds

The B.P. and reagent qualities of liquor ammonia are made in all concentrations from 0.880 to 0.940 specific gravity, whilst the carbonate and bicarbonate of ammonia are produced in grades conforming to both standards. Chief among the sodium compounds made to both B.P. and reagent quality is the hydroxide, a specially pure product of electrolytic origin, whilst of the nine standard grades of bicarbonate eight are guaranteed to conform to the 1932 British Pharmacopoeia. Sodium carbonate monohydrate is also produced as an extremely pure product, containing not more than 0.025 per cent. of total impurities other than water.

Stannous chloride, which commands a fairly high price as a reducing agent, is put up in small quantities of reagent quality, whilst the cyanides of sodium and potassium are made to British Standards Specification only. Sodium peroxide is made in strengths much higher than the standard reagent qualities call for, and sodium thiosulphate is manufactured as an especially fine product for photographic purposes to B.P. (Codex) specification. A very pure form of metallic sodium is also manufactured; bleaching powder is produced in a B.P. grade, carbon disulphide to reagent quality and B.S.S. standards, whilst it is interesting to find distilled water on the I.C.I. range of B.P. chemicals.

Among the pure inorganic products for which no definite specifications exist may be mentioned ammonium sulphite monohydrate, which has a certain limited application in the preparation of dyestuffs intermediates, but which has also had possible uses suggested for it as a reducing bleach, fruit preservative and wood pulping agent. Another fine chemical on this range is antimony pentachloride, which finds its principal application as a chlorine carrier in organic syntheses.

Organic Chemicals

Urea, which finds pharmaceutical application as a diuretic and in testing the functional efficiency of the kidneys, is manufactured in a grade which easily meets the requirement of the 1932 British Pharmacopoeia—namely, that it shall leave on incineration not more than 0.1 per cent. of residue. Other B.P. organics on the range include glacial acetaic acid (made also to reagent quality and B.S.S. specifications), 1 ml. of the normal representative product complying with the limit test for chlorides: chloroform for medical use, made also to reagent quality; and formic acid, made to B.P. (Codex) standard, and whose main applications calling for a pure product are as a dyebath assistant, as a coagulating agent for rubber, and in the leather industry for neutralising hides after lining. Benzoic acid and sodium benzoate are also produced to B.P. specification.

A medicinal chemical of interest is B.P. paraldehyde, which may also be regarded as a conveniently transportable source of acetaldehyde, obtainable from it with a trace of mineral acid. Although not on the B.P. or other lists, mention should also be made of benzyl, benzoyl, ethyl, methyl, sulphuryl and thionyl chlorides—all useful agents in the laboratory as well as in the works, sulphuryl and thionyl chloride being of particular use in the manufacture of acid chlorides.

Methanol is marketed in reagent quality, a specially pure product of low acetone content, obtained by redistillation of pure methanol. Among the well-known series of chlorinated non-inflammable solvents, trichlorethylene is marketed in a non-inflammable solvents, trichlorethylene is marketed in a pure form, and in a grade for medical purposes, all grades of the product complying with British Standard Specification No. 580 for trichlorethylene. Perchlorethylene, tetrachlorethane and pentachlorethane are all manufactured as pure products with a narrow boiling range. Tetra- and decahydronaphthalene are manufactured by the hydrogenation of pure naphthalene, yielding water-white liquids of narrow boiling range, high flash-point and low sulphur content.

Deuterium Compounds for Research

It is only two years ago since Professor Urey, of New York, isolated the heavier isotope of hydrogen in the form of its oxide, heavy water. The preparation of this deuterium oxide is a long and expensive process, and is only possible on a commercial scale where exceptional resources of power and raw materials co-exist, as they do at Billingham. Imperial Chemical Industries, Ltd., now offer for sale not only "heavy water" (in two grades, containing 99 per cent. and 99.95 per cent. D_2O respectively) but also 95 per cent. sulphuric acid, 92 per cent. nitric acid, 40 per cent. caustic soda, 33 per cent. hydrochloric acid, 30 per cent. ammonia and 40 per cent. oleum, of the total hydrogen atoms in all of which, at least 95 per cent., are deuterium. In industry thus providing for the research worker we see a reversal of the traditional sequence; and, while it is too early yet to forecast any definite commercial uses for deuterium compounds, they have already found application as a new tool in the hands of the research worker concerned with the investigation of the movements of atoms during chemical change.

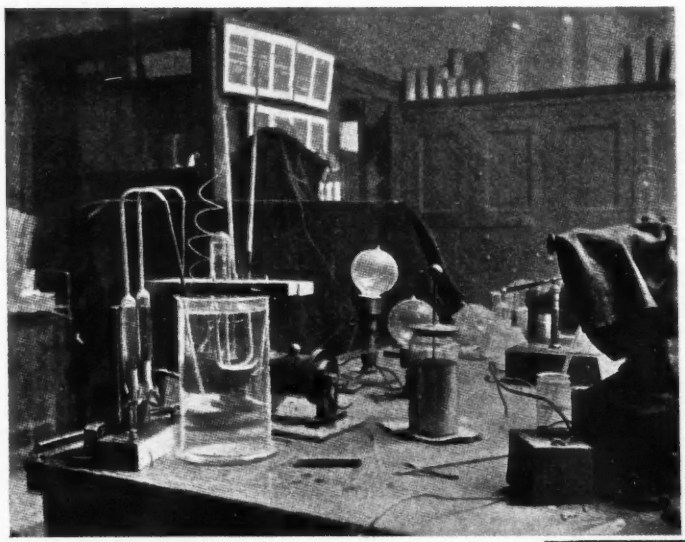
Scientists of the Past Generation

Lord Rayleigh's Reminiscences of Men and Their Surroundings

LORD RAYLEIGH, F.R.S., in his presidential address to the Physical Society at the Imperial College of Science on January 24, departed from precedent and took the opportunity of telling the Society something of his recollections of eminent scientific men of a past generation and the circumstances under which they worked.

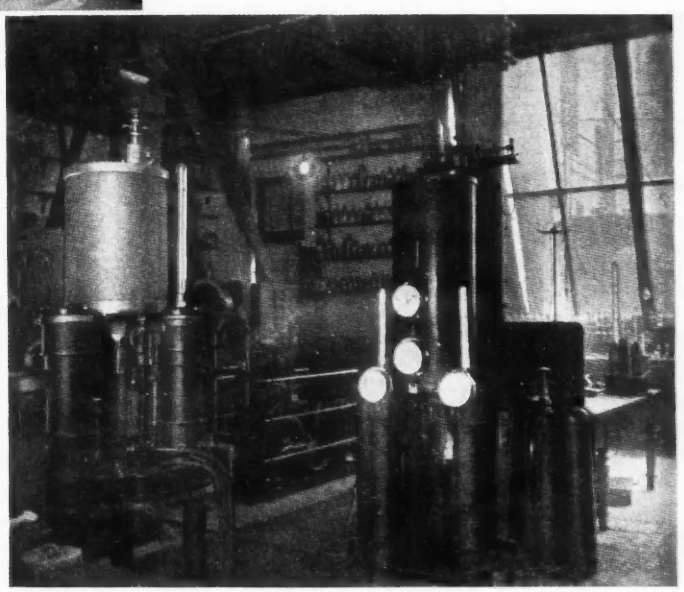
Describing Lord Kelvin (1824-1907), whom he knew intimately from almost his earliest recollections up to his death in 1907, Lord Rayleigh said his scientific calculations were done in a quarto note book, his famous "green book" which he carried for the purpose. He wore tail coats with large side pockets, rather like a gamekeeper's pockets, in one of which the book was kept. The "green book" was produced, and the calculations proceeded with, on what might seem most unsuitable occasions. He seemed to find distractions rather helpful than otherwise, and would bring his work for preference into the drawing-room where ladies were gossiping, rather than avail himself of a quiet room. He would join in their conversation at intervals. To be as insensitive to interruption as Lord Kelvin was a valuable gift, and an unusual one. He did not always realise that other people lacked it. There was a saying in the natural philosophy department at Glasgow University when he was Sir William Thomson that "the Knight cometh when no man can work." The work of calculation went forward during train journeys, or in a hansom cab. During the sittings of the Royal Commission on Arsenical Poisoning from Beer (1901), of which he was chairman, he would put his own questions to a witness, and then relapse into calculations while his colleagues were putting theirs: and he was similarly occupied when sitting on the platform during a not very inspiring presidential address to the British Association.

Lord Kelvin's mind was not readily satisfied with any theory which did not lend itself to the formation of a mental picture. He required mechanical analogies, and it was perhaps partly for this reason that he was so much dissatisfied with the electro-magnetic theory of light, which (in some moods at least) he did not consider could rank as a theory of light at all. He had humour of a kind, but it was somewhat elementary, and he did not disdain puns, which were still fashionable when he was young. Lord Kelvin once argued with Lord Rutherford and the speaker about atomic disintegration, and Lord Rayleigh, an enthusiastic champion of Rutherford's views, bet Lord Kelvin 5s. that within three (or perhaps six) months he would admit that Rutherford was right. Lord Kelvin did change his views within the period, and when next he saw Lord Rayleigh he promptly paid the debt.



Small scale argon apparatus at the Physical Laboratory of the Royal Institution. The most conspicuous object is a small sparking vessel of test tube form, standing over alkali, and the voltmeter used to feed in oxygen, or hydrogen for the removal of surplus oxygen.

Lord Rayleigh proceeded to give a picture of the Royal Institution as it was during the time of Dewar and the third Lord Rayleigh. Dewar, anxious to obtain helium for his attempts to liquefy that gas, was told by Rayleigh that it bubbled up from the hot spring at Bath. Dewar got the consent of the Corporation of Bath to collect gas from the spring, and the gas was sent to London in steel cylinders. The helium was present in only about one-thousandth part of the whole, and was necessarily expensive. But the real trouble was that the helium from Bath gas contained a high proportion of neon, which could not readily be removed by the methods adopted. From this point of view it seemed a misfortune that helium was ever found in the gas at Bath, because Dewar, had he obtained his helium from monazite, might have succeeded in the liquefaction. Dewar was very secretive about his work and kept visitors away from his laboratory so far as possible. This could not be due to the commercial value of unpatented knowledge, as Dewar gave his invention of the vacuum flask freely to the world and never made a penny by it. In his rooms (formerly



Plant for liquefying gases at the Chemical Laboratory of the Royal Institution.

occupied by Faraday and Tyndall) he kept a pair of Renaissance bellows bearing traces of a signature, with place and date, which led him to attribute them to Benvenuto Cellini. Dewar's chief assistant, Robert Lennox, was interested in an acid-resisting iron alloy. Its peculiarities had been noticed by a workman, who remarked, "'T ain't iron." From this incident, said Lord Rayleigh, the trade name Tantiron was adopted.

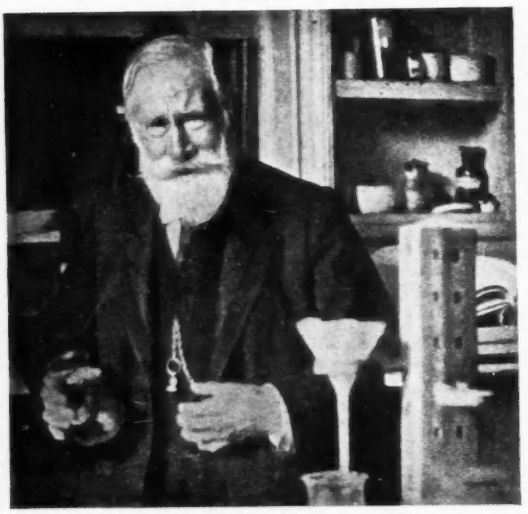
Speaking of Sir William Crookes (1832-1919), Lord Rayleigh said that, like Faraday, he was of somewhat humble origin, and largely self-taught. Like Faraday, he was skilful in experimental technique, and relied mainly on his own intuition rather than on any very definite reasoning to guide him as to the subjects to be taken up: and like Faraday he was without the measure of mathematical training now expected from every serious student of physics or physical chemistry. When he was in his prime, an equipment of this kind was by no means inadequate, as Crookes's own career clearly proved; and it might be suspected that even now, too keen a critical faculty, and too much knowledge of what had been done by others, was not always an unmixed advantage to one who aspired to be a pioneer in new fields. Crookes started more absolutely new hares than any other man among his scientific contemporaries. One of the most notable, the radiometer, made its appearance at a time when scientific sensations were not so frequent as they have since become, and it excited a widespread interest. Radiometers were to be seen in the shop windows of chemists and opticians all over London, and in provincial cities as well. They excited the curiosity of almost anyone as they spun round vigorously in the sunlight.

It was a source of annoyance to Crookes that he had missed the discovery of the X-rays. According to an account he gave in Lord Rayleigh's hearing, he had definitely found previously unopened boxes of plates in his laboratory to be fogged for no assignable reason, and, acting in accordance with the usual human instinct of blaming someone else when things go wrong, he complained to the makers, who naturally

Robert Lennox, Dewar's chief assistant, who was with him from 1881 to 1908, in the Lecture Theatre of the Royal Institution.

had no satisfactory explanation to offer. It was only after Röntgen's discovery that he connected this with the use of highly exhausted vacuum tubes in the neighbourhood. He had, at least, less to reproach himself for than another English man of science, who, it was said, knew that high vacuum discharge tubes were apt to fog photographic plates anywhere near them, and only drew the moral that the plates should be stored elsewhere.

Crookes was deeply interested in the properties of the diamond, and in the peculiarities of individual diamonds. He was in touch with the De Beers Co., and he spoke with contempt of the action of "our precious government" in driving the company's headquarters from London to South Africa, as a result of income tax regulations. He had early observed the brilliant phosphorescence of some unusual diamonds under cathode rays, or "radiant matter" in his own phrase. Later, he repeated the experiments of Moissan on the artificial production of diamonds in the electric furnace, and considered that he had confirmed the results. However, after Crookes's death, the hard crystals which he had



Sir William Crookes in his chemical laboratory, near the end of his life.

obtained came into the hands of Sir Charles Parsons, who was unable to induce them to burn in oxygen, and concluded that Crookes's identification of them as diamonds was mistaken.

Both Crookes and Dewar were connected with the Royal Institution, the former as secretary and the latter as Fullerian Professor of Chemistry and director of the laboratory. After their joint work on water analysis they quarrelled and their partnership was dissolved. There was therefore an *impasse*, and Crookes placed himself in the hands of the Duke of Northumberland as president of the Institution. The Duke took the view that as Crookes was to be president of the Royal Society, he could stand back without loss of dignity, and at the Duke's request he did so, though not very willingly. Crookes was never able completely to forget or forgive, but whatever his feelings may have been, he did not allow them to influence his actions. As president of the Royal Society he brought forward Dewar's name for the Society's greatest honour—the Copley Medal—and drew up a statement of Dewar's scientific merits in support. This was written with great care so as to do strict justice, without being in any way fulsome.

Shortly after the declaration of war in 1914 Crookes brought forward a method of secret night signalling which he had worked out in collaboration with his assistant, Mr. Gardiner. During the war he served as a member of the Admiralty Board of Invention and Research. He was always treated with especial courtesy and consideration by Lord Fisher, the chairman, as was indeed fitting in view of his age and position. It cannot be said that he contributed much to the proceedings, and his activity was diminishing. But he went on to the end, his last paper appearing in his eighty-seventh year. He died while it was passing through the Press.

Dealing with Sir Arthur Schuster (1851-1934), Lord Rayleigh said he was one of the now fast diminishing band who derived personal inspiration from Clerk-Maxwell. He used to deplore the fact that the rising generation of physicists did not study Maxwell's great book on electricity and mag-

netism at first hand, but were content to derive their knowledge from secondary sources. He forgot, perhaps, the demands made on the student by the ever-widening range of scientific knowledge, and the necessity for learning established doctrine in whatever way may be the easiest.

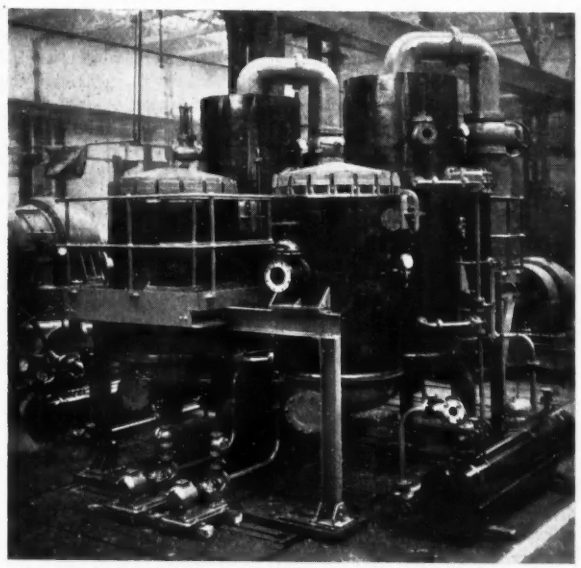
For Schuster, science consisted mainly in the discovery of scientific facts and laws, not in applying them to the service of man. So well-balanced a mind could not fail to understand how great are the difficulties which inventors have to overcome: but these triumphs were not the things in which he personally delighted. Schuster was near making some of the most important discoveries of his day. He used to tell how in early days he looked for the effect of a magnetic field on spectrum lines, subsequently discovered by Zeeman. Having arranged the experiment, with his eye to the spectroscope, he turned on the electromagnet and observed a large broadening of the lines. At first his hopes were high. But further investigation showed that what he had seen was to be explained by the magnet pulling apart the steel jaws of the slit! He was perhaps the first to realise the important information that could be gained by a quantitative measurement of the deflection of cathode rays in a magnetic field. He carried out measurements of this kind himself, and drew provisional conclusions, but these failed of success through his having over-estimated the effect of the resistance of the gas on the motion of the particles. Possibly if he had been gifted with a somewhat more vigorous physique, he would have been able to push these investigations to ultimate success in both cases. It was clear that he had the root of the matter. As secretary of the Royal Society, Schuster always took a broad point of view about the scientific work on which it was his duty to form a provisional judgment. With his great interest in the history of science, he had taken to heart the lesson that the orthodox view was not necessarily right.

In the early phases of the war, the hysterical outbreaks of spy mania made difficult the position even of British subjects of long standing who had been born in Germany. Schuster was one of the sufferers, and the fact that he had installed at his house a wireless receiving set for getting the time from the Eiffel Tower station gave a handle for the most grotesque misrepresentations. This was, of course, before the days of broadcasting, and wireless receiving sets were not in general domestic use. Attempts were even made to eject him from his position as secretary of the Royal Society. In hours of relaxation, the subjects on which he chiefly liked to dwell were science and the personalities and idiosyncrasies of scientific men. Politics hardly seemed to interest him at all, and he made no effort to join in when such subjects were under discussion. During his holidays he made charming water colour sketches which he would show with some legitimate pride to his friends. His interest in art extended considerably beyond the range of that branch of it which he himself practised. Towards the end of his life, when his health had finally given way, he said that to find himself remembered by his old friends was the only pleasure that remained to him.

Evaporators for Boiler Feed Water

A Notable Installation at Newport

THE use of pure distilled water for boiler "make-up" is ably illustrated by an installation of two single effect evaporators at the East Power Station of the County Borough of Newport, South Wales. These evaporators have been installed by Hick, Hargreaves and Co., Ltd., and are



Two single effect evaporators installed by Hick, Hargreaves and Co., Ltd., at the East Power Station of the County Borough of Newport.

representative of their latest designs. One unit operates in conjunction with No. 3 turbo-generator and is capable of giving 6,780 lb. of water vapour per hour under the reduced pressure conditions of 6 lb. per square inch absolute, discharged to the feed circuit, and is supplied with heating steam at 35 lb. per square inch absolute, bled from the turbine to evaporate the raw water. The other evaporator working with the No. 4 turbo-alternator is capable of a duty of 6,875 lb. of water vapour per hour at 6 lb. absolute, when supplied with bled steam at 16 lb. absolute.

Each evaporator consists of one calandria or cylindrical tubular heat exchange unit, connected to a cast iron cylindrical evaporator body. The calandria has a mild steel body with cast iron heads and a series of vertical large bore solid drawn copper tubes, expanded into tube plates. Steam for heating, bled from the corresponding turbine, enters at the top and passes down outside the tubes discharging from the bottom as hot condensed water, also passed into the feed circuit. The raw water travels up inside the copper tubes in countercurrent to the outside heating steam and passes from the top into the evaporator body, from the top of which the water vapour is discharged to the feed.

Included in the equipment are automatic float control feed valves, so that the water being evaporated is maintained automatically at a constant level, irrespective of the vapour demand, and primary and secondary separators to remove suspended water particles from the vapour. Each evaporator also has a heat interchange vapour cooler for passing the latent heat to the boiler feed, and a pre-heater to raise the temperature of the incoming raw water by the sensible heat from the calandria condensate.

The increasing size, pressure, and general complexity of water-tube boilers is rendering the use of distilled water a pronounced advantage, since the make-up contains no trace of materials likely to cause a film of scale in the tubes, and no soluble salts of a non-scaling character which may tend to cause frothing and priming. Double and triple effect evaporators are also manufactured by Hick Hargreaves and Co., Ltd. One evaporator body may have several calandria using heating steam from different sources and at different pressure, in order to maintain automatically any desired rate of evaporation if the main sources of exhaust or lower pressure steam is variable in amount.

Plasticisers in Cellulose Ester Plastics

Dr. T. H. Durrans Discusses Certain Aspects of Application

AN interesting paper on "Plasticisers in Cellulose Esters" was read by Dr. T. H. Durrans, D.Sc., F.I.C., of A. Boake, Roberts and Co., Ltd., at a meeting of the Liverpool Section of the Society of Chemical Industry on January 17, Mr. D. G. Davidson being a joint author. Professor C. O. Bannister presided over the meeting, which was held jointly with the Plastics Group.

Plasticisers in general, said Dr. Durrans, had the effect of rendering cellulose esters less elastic and more plastic. When plasticising a cellulose ester it was often necessary to employ a volatile solvent to effect the proper distribution of the plasticiser in the cellulose ester, and it was essential to have a knowledge of the fate of the solvent at the completion of the operation. Referring to the use of high-boiling solvents or low-boiling plasticisers, Dr. Durrans said the phenomena known as "chilling" tended to occur when highly volatile solvents were used. Chilling was due to the disposition of water caused by the lowering of the temperature of the film and the air in its immediate neighbourhood to below the dew point by the high rate of evaporation which occurred with highly volatile solvents; by adding a solvent having a slower evaporation rate, this defect could be eliminated. Theoretically, a medium boiling solvent reduced the vapour pressure and consequently slowed up the rate of evaporation more than would a similar weight of a high boiling solvent.

These considerations applied to the early stage in the evaporation of a solution of a cellulose ester in a mixture of solvents. When the later stages of the evaporation were reached other considerations applied. If a layer of a solution of a cellulose ester was allowed to evaporate, the rate at which the solvent left the layer slowed progressively, the lacquer became more and more viscous and the molecules of solvent diffused more and more slowly to the surface from which evaporation took place. At this stage the size of the molecules of the solvent was the prime factor governing the rate of evaporation; the larger the molecule the lower the diffusion to the surface. Hence, the solvent which it was desired to eliminate from the film should have a small molecule, while for plasticisers substances of high molecular weight were desirable both for this reason and for the concomitant property of low volatility; there was, however, a practical limit in the case of plasticisers beyond which no useful purpose was served and which arose in the manufacture of plasticisers.

Solid Analogue of Castor Oil

With masses of considerable thickness the tendency should be to avoid the use of low-boiling solvents and to rely not on loss of solvent to effect rigidity but on the adequate dispersion of the solvent in the cellulose ester. The use of a solvent plasticiser permitted a plastic which was solid at ordinary temperatures to become, on heating, sufficiently soft and ductile to be pressed and moulded into desired shapes; with non-solvent softeners of the castor oil type, the use of heat and pressure merely resulted in the expression of the oil without sufficient softening of the cellulose nitrate to permit moulding.

During the last few years a number of patents had been obtained for the use of resins as plasticisers for cellulose esters; substances of this type were of two types. The first type had no solvent action on cellulose esters; they might be regarded as the solid analogue of castor oil which was merely held in the intercellular spaces in the cellulose ester, forming no "compound" therewith. Such resins gave opaque mixtures due to the existence of two solid phases, but these could be brought into a one-phase solution by the addition of a plasticiser which was a neutral solvent for both the resin and the cellulose ester, thus changing the hard, elastic, but brittle, mass into a more plastic and more transparent mass. The second type of resin, of which there were but few, was in itself a solvent for the cellulose ester. The addition of a plasticiser, which was a solvent for the resin, caused a lowering of the softening point; a resin which was itself a solvent for the cellulose ester required no such addition and the softening point was in consequence not lowered. Resins which did not form solutions with cellulose nitrate lowered the plasticity and increased durability and weather resistance and might be used in large proportions. The lines of demarcation between high-boiling solvents, plasticisers and resins as regards volatility could not be accurately defined; it could, however, be said that the volatility of the resins was so low that it might be ignored, but there was great difficulty in deciding where to draw the line between the other two.

Result of a Deficiency of Plasticiser

The proportion of plasticiser which could be dissolved by a cellulose ester varied considerably, not only with the plasticiser and cellulose ester but also in some cases with the temperature. Many plasticisers could be used in any proportion with a cellulose ester without exhibiting synaeresis, but in such cases excess of plasticiser gave rise to excessively soft plastic products having a low tensile strength and high non-reversible extensibility, and which were easily damaged by impact or abrasure and broke readily if subjected to sudden stress. A deficiency of plasticiser resulted in a mass that could not adapt itself to the stresses imposed upon it, either externally or internally, due to loss of volatile solvent if such had been used. This resulted in a general break-up of the mass, which had but a short life in consequence.

Esters of polycarboxylic acids offered a wide field for the production of plasticisers and had the advantage that polycarboxylic acids, such as phthalic, oxalic, citric, tartaric and sebacic, were cheap. The permutation and combination possible with esters of this class had exercised *ad nauseam* the misplaced ingenuity of so-called inventors for some time, and it was only occasionally that products worthy of special notice were described. Among those of special interest were the methylene glycol esters of polycarboxylic acids. The production of polycarboxylic acids from petroleum presented aspects of considerable potential interest. The use of naphthenic acids for the production of plasticisers was well known; a somewhat similar procedure was to oxidise destructively paraffin waxes by means of nitric acid and to esterify the acids of high acid value thus obtained. The esterification of the acids of about 500 acid value with isobutyl alcohol yielded a mixture of colourless esters of high-boiling range which were said to yield clear elastic films with cellulose nitrate in proportions of 50 per cent.

Resinous Plasticisers

Another instance of the use of petroleum as a source of materials from which to prepare plasticisers was the preparation of esters of the 4-cyclohexene 1-2-dicarboxylic acid; this acid was prepared by the action of maleic acid on liquid fractions containing butadienes, which were obtained during the cracking of petroleum. The dibutyl ester boiled at over 300° and was a solvent for cellulose nitrate. Amongst the resinous plasticisers were the well-known ethyl and benzyl acetates which were in effect fluid forms of glyceryl abietate, known generally as ester gum. These had little or no solvent power for cellulose esters and required the addition of a solvent-plasticiser if the proportion was to exceed but a few per cent., but hydrogenation was said to increase their compatibility, proportions approaching 20 per cent. being permissible with cellulose nitrate.

Hydrogen Production by the Badische Process—XI.

Economics of the Process

This instalment completes the two special series of chemical engineering articles which THE CHEMICAL AGE commenced publishing on October 5, 1935. The first series, entitled "Economies of the Synthetic Manufacture of Ammonia," appeared each week from October 5 to November 16, 1935, inclusive. The second series, entitled "Hydrogen Manufacture by the Badische Process," commenced on November 23, 1935, and has appeared each week (excepting December 28) until the present instalment.

LAST week it was pointed out that the choice of the scheme of manufacture depended on decision as to the following points: (1) By what means the CO_2 is removed. (2) By what means the CO is removed. (3) Whether, if water scrubbing is used to remove CO_2, this is done before or after the removal of CO. (4) Whether nitrogen should be made separately in a liquefaction plant or along with the water gas. (5) Whether the process is as economical as the steam iron process. The first two have already been dealt with, and the remainder are discussed below.

(3) *Position of the CO_2 Scrubbing Plant.*

The reason already given for the position chosen, *i.e.*, before the fractional combustion, is that it is doubtful whether all the CO could be removed in presence of the CO_2 by that process.

If it were possible to remove the CO in presence of the CO_2 and the pressure washing was carried out after the fractional combustion; there would be the advantage, that it would not be essential to let the pressure down again after the scrubbing; the storage gasometer could come before the pressure working and the gas after leaving the latter would be returned to the compressors and taken to the higher pressure for the Haber plant.

This does not allow much elasticity in the process. It also means that caustic soda scrubbing would be necessary for the removal of the last percentage of CO_2, which would be as costly in soda as the removal of about 4 per cent. of CO_2 by lime would be at the low pressure, it would require a large number of pressure scrubbers (about 50 14-ft. scrubbers).

Further, the fractional combustion plant would be increased by one-third owing to the large quantity of gas which would have to be treated if the CO_2 was present. Nitrogen could not be added till a later stage, otherwise preheating would be required which would be wasteful.

The pressure washing helps to remove H_2S, which must be absent from the gas going to the fractional combustion catalyst; and so the position before the latter is more to be favoured in this respect. The only real advantage of the position following the fractional combustion is the saving of power if the pressure is not let down. It would amount (as a maximum) to 1,450−460=990 K.W.

$$= \frac{990 \times 24}{9,540} \times 0.25 = 0.69\text{d. per 1,000 cu. ft. of hydrogen.}$$

The total compression plant would not have to be so large and there would follow a small saving on capital expenditure.

On the whole, despite success in the direction of removal of CO in presence of CO_2 by fractional combustion, it is doubtful whether these latter advantages outweigh the disadvantage mentioned above. Anyhow, there is a decided disadvantage in the position after the fractional combustion, if the pressure is subsequently let down to gain elasticity in the process.

(4) *Nitrogen Manufacture.*

It is open to question whether it is more economical to make nitrogen along with the water gas (1) by letting in a little air along with the steam in the water gas generators, or (2) by liquefying the air separately and introducing the nitrogen so made towards the end of the process. It is further a possibility to make the nitrogen from exhaust gases for gas engines, giving power for the compressing plant or from nitrogen derived from the ammonia soda process after water scrubbing. For the present purpose there is no need to discuss the two latter propositions.

Case I: If made in the *water gas generators*:—

Quantity of water gas required = 3,418,000 cu. ft. per day.

Maximum quantity to be brought in from air in fractional combustion and in normal water gas supply = 2,102,000 cu. ft.

Therefore minimum quantity required from producers = 1,316,000 cu. ft.

Case II: If made by *liquefaction*:—

Quantity of nitrogen required = 3,216,000 cu. ft. per day.

Maximum quantity to be brought in from air by fractional combustion and in normal water gas supply = 2,102,000 cu. ft.

Therefore, quantity required from liquefaction plant = 1,102,000 cu. ft.

Thus, in Case I, an extra volume of 1,316,000 cu. ft. at least has to be passed through the converters, iron oxide boxes, scrubbing plant.

Additional numbers of converters required

$$= \frac{17,600,000}{16,300,000} = 2.15, \text{ say 2 extra convertors.}$$

The extra number required, however, may be more, as the dilution of the gas will decrease the rate of action and more catalyst would be required, and probably more steam.

If the steam/water gas ratio is retained as 3/1, then the additional quantity of steam required would be:—

$$17.6 \times 700 = 755 \text{ or } 55 \text{ tons of steam}$$
$$= 7.85 \text{ tons of coal,}$$
$$= 7.85 \times 240\text{d.} = 0.22\text{d. per 1,000 cu. ft. hydrogen.}$$

It would also, in all probability, be necessary to continuously preheat the gas, say, to about 200° C. to keep the action going, for the efficiency of interchange for autothermic working would have to be nearly 90 per cent.

Approximately the extra heat required would be:—

$$\frac{11,800,000 + 1,316,000}{1,440} \times 0.426 \times 0.43 \times 180 = 25,000$$

$$\text{Plus } 1,090 \times 100 \times 0.47 = \frac{51,000}{76,000} \text{ C.H.U. per min.}$$

$$= \frac{76,000}{3,000} \text{ C.H.U.} = 25.3 \text{ lb. coal at } 50\% \text{ efficiency.}$$

Therefore, for 1,000 cu. ft. of hydrogen

$$= \frac{25.3}{5.92} = 4.29 \text{ lb. coal}$$
$$= 4.29 \times 0.107 = 0.46\text{d.}$$

The volume of gas is not greatly increased, so that the oxide box installation would be only very slightly larger. The compressing plant, however, would be increased by about one compressor; the minimum extra volume of gas is $\frac{1,316,000}{1,440} = 910$ cu. ft. per minute, and one compressor deals with a maximum of 2,000 cu. ft. per minute. An additional expansion engine would be required and another two scrubbers.

The extra power for compression required would be about

$$\frac{990 + 910}{11,300} = 82 \text{ h.p.}$$

That for water scrubbing would only be

$$\frac{460 \times 910}{11,300} = 37 \text{ h.p.}$$

assuming that a quantity of water is required relative to the total quantity of gas to be scrubbed, which is approximately the case.

Therefore, energy required:

$$.745 \times \frac{119 \times 24}{8,540} \times 0.25 = .06\text{d. per per 1,000 cu. ft. hydrogen.}$$

The quantity of argon in the final gas would be

$$\frac{1.1}{100} \times 3,418,000 = 37,800 \text{ cu. ft., or } \frac{37,800}{12,903,000} = 0.29\%$$

This entails a loss of hydrogen, when the gases are blown off when the argon reaches 5 per cent., and if x = volume of hydrogen and nitrogen with which the argon which is blown off was associated :—

$$\frac{5}{x+5} = 0.29 \text{ or } x = 1.72$$

and the percentage of hydrogen and nitrogen lost

$$= \frac{95 \times 100}{1.72} = 5.5\%.$$

In the second case, the volume of nitrogen derived from the air direct is only 2,102,000 cu. ft. or 23,100 cu. ft. of argon = 0.18 per cent., so that the percentage of hydrogen and nitrogen lost would be 3.4 per cent., so that the additional loss of hydrogen and nitrogen in Case I would be 2.1 per cent. If the hydrogen costs (say) 24d. per 1,000 cu. ft. this amounts to 0.5d.

In Case II, the minimum quantity of nitrogen from the liquefaction plant required would be 1,102,000 cu. ft. per 24 hours.

One 1,000 c.m. machine consisting of compressor, expansion engine, vaporiser, and liquefier would give 850,000 cu. ft. per 24 hours. Either one 1,500 c.m or two 1,000 c.m. machines would therefore be required (spares in all cases would have to be allowed for).

The power required is 350 h.p. per 850,000 cu. ft. per 24 hours :—

$$= \frac{24 \times 350 \times 0.746 \times 0.25\text{d.} \times 1,102,000}{850,000 \times 8,540}$$
$$= 0.238\text{d. per 1,000 cu. ft. hydrogen.}$$

There are other small costs for lime, water, etc., but these would weigh nearly equally with the Case I method. The capital expenditure will be greater in the latter case as the extra plant required, *viz.*, two compressors and liquefiers, instead of one compressor and the expansion engine, but the difference would not be very great.

The actual cost of production of nitrogen is about 6d. per 1,000 cu. ft., so that the total cost of the nitrogen required per 1,000 cu. ft. of hydrogen should be

$$\frac{1,102,000}{8,540,000} \times 6\text{d.} = 0.77\text{d.},$$

allowing a certain margin, as the above requirement 1,102,000 is a minimum and might be increased 20 per cent., say, 1d. per 1,000 cu. ft. hydrogen.

Thus the expenses under Case I, without labour and capital charges, come to : Extra steam for converters 0.22d., fuel for preheating 0.46d., extra power for compression, etc., 0.06d., loss due to argon 0.50d.; Total per 1,000 cu. ft. hydrogen 1.24d.

It appears therefore that it would be decidedly better to install the nitrogen liquefaction plant under the circumstances when part of the nitrogen is derived from the air let in with the fractional combustion. There are the further advantages, that (a) the water gas plant can be controlled better so as to give a good quality of water gas; the addition of air would have raised the temperature and probably led to more methane, etc., being formed, and other difficulties. (b) There is great elasticity in the process; the nitrogen can be added to make an exact mixture for the Haber plant, and to adjust any fluctuations in the nitrogen content of the gas, which would otherwise be difficult without losing more hydrogen in the fractional combustion than is desirable.

It should be noted that only two units, (say) two 500 c.m. machines and one 1,000 c.m. machine (allowing for spare) would be necessary for the plant described, whereas four or even five 1,000 c.m. machines would be necessary, if the Lane process was adopted.

The fractional combustion method of removal of CO is thus an asset in so far as it provides a large part of the nitrogen required for the process at no cost. If other methods of removing the CO were employed, which did not introduce nitrogen, it is probable that the method of making the nitrogen along with the water gas would be slightly cheaper than the liquefaction method, and save considerable capital expenditure. When nitrogen is not required in the gas (*e.g.*, for fat hardening, aeronautical purposes, etc.) the fractional combustion method is unsuitable.

The small liquefaction plant required would provide a certain quantity of oxygen, and it would certainly be an advantage if this could be obtained in a pure state; about 440,000 cu. ft. of oxygen would be available per day, and, if about 70 per cent. of this was obtained pure, 300,000 cu. ft. per day would be obtained, this would be a marketable quantity, if it could not be used for other purposes in the factory.

(5) *Comparative Cost of Catalytic and Steam Iron Process.*

It is now possible to provide a rough estimate of the relative merits of these two processes for manufacture of hydrogen for the Haber process.

Materials required per 1,000 *cu. ft. hydrogen* : *Catalytic Process* for 8,540,000 cu. ft. hydrogen (allowing about 13 per cent. to spare).

		Badische.	Estimate.
Coke at 20$	56 lb.	6.0	8.75
Coal at 20$	35 lb.	3.75	1.90
Power at 0.25d. per K.W.H.	3.66 K.W.H.	0.92	0.10
Lime at 15$ per ton	4.6 (lower estimate when NH_3 used)	0.37	0.68
Water at 1d. per 1,000 gal.	650 gal.	0.65	2.5
CO Purification			1.3
Contact Mast			1.0
Total		11.69d.	16.24

Steam Iron Process : The following table gives three low estimates of the cost of production of hydrogen by the steam iron process (Lane type).

The first estimate is based on : (1) A yield of water gas/hydrogen, of 2.5/1, which is almost the theoretically optimum figure; the coke to water gas being taken the same as for the catalytic process, *viz.*, 40 lb. per 1,000 cu. ft. (2) A yield of $\frac{280 \times 3}{4}$ = 210 lb. steam per 1,000 cu. ft. hydrogen = 30 lb. of coal, which is about an optimum figure and is based on the maximum production per bench of retorts. (3) A quantity of CO_2 in the issuing gas of 2 per cent. which is a low average.

The second estimate is based on an estimate for a large plant of 5 million cu. ft. hydrogen per 24 hours capacity.

The third estimate on an average sample of their present figures for a plant of about 450,000 cu. ft. hydrogen per 24 hours capacity. This is a low estimate compared with other plants. The same basic figures for prices have been used throughout.

Material	Estimate 1.	d.	Estimate 2.	d.	Estimate 3 d.
Coke at 20$ per ton	100 lb.	10.7	144 lb.	15.40	17.1
Coal at 20$ per ton	30 lb.	3.22	60 lb	6 40	7.9
Lime at 15$ per ton	5.9 lb.	0.47	4.5 lb.	0.36	0.37
Water at 1d. per 1,000 gal.	4.0 gal.	.04	—		1 54
Power at 0.25d. per K.W.H.	0.65 K.W.H.	0.16	—		0'45
Iron ore at 42$ per ton	?		5.6 lb.	1.26	2.0?
Total		14.59		23.42	28.36

The advantage the catalytic process possesses in respect of materials will therefore lie somewhere between 4½d. and 12d. per 1,000 cu. ft. of hydrogen.

As regards *maintenance,* there is little to go upon. The maintenance charge on the present Lane plants is high—*viz.*, about 11d. per 1,000 cu. ft. On a large plant this might be reduced to 3d. or 4d. The converter plant of the catalytic process ought not to require much expenditure or maintenance. On the other hand, such maintenance charges for the pressure washing plant as might be necessary would be of rather a costly nature, though they ought not to be frequent.

Institute of Chemistry

January Examinations

THE Institute of Chemistry has issued its pass list based upon the January examinations as follows:

Examination in General Chemistry for the Associateship:—A. J Brookes, Central Technical College, Birmingham; H. Catlow, City Technical College, Liverpool; A. Davies, B.Sc. (Lond.), Chelsea Polytechnic, and University College, London; L. C. Dutton, City Technical College, Liverpool; W. T. Edwards, Central Technical College, Birmingham; G. D. Fidler, University College, Nottingham; F. H. Grimbleby, B.Sc. (Leeds), The University, Leeds; Miss Ida Harcourt-Vernon, M.Sc. (Sheffield), The University, Sheffield, and Chelsea Polytechnic; A. Macarthur, A.M.C.T., The College of Technology, Manchester; J. H. Mallows, City Technical College, Liverpool; R. H. McLintic, The Polytechnic, Regent Street; K. M. Pandalai, B.A. (Madras), M.Sc. (Allahabad), The University, Madras, and Muir Central College, Allahabad; F. C. Shuter, Central Technical College, Birmingham; W. R. Stanton, Central Technical College, Birmingham; L. Taylor, B.Sc. (Lond.), College of Technology, Manchester.

China Clay Prosperity

Annual Meeting of English Clays Lovering Pochin and Co., Ltd.

PRESIDING at the third annual meeting of English Clays Lovering Pochin and Co., Ltd., in London, on January 29, Lord Aberconway announced the completion of negotiations for the purchase of additional freeholds which would materially help the company to arrange the working of its mines in the interests of economy and efficiency. As the result of the year's trading the balance to the credit of profit and loss account had increased from £120,352 to £161,581, a result which reflected great credit on all the members of the staff. Mr. A. Davies, general manager in charge of production, had been appointed to a seat on the board.

The fact that the company was an amalgamation of several concerns, and therefore owned a large number of mines, producing a great range of different clays, enabled it to give substantially better services to customers than was the case before they joined forces. They were not only able to keep larger aggregate stocks at works and depots, but they could readily supply the type of clay best suited for customers' special requirements. During the last three years they had made the most strenuous efforts to produce clays to an increasingly high standard of quality. They had established a research department, which had made a scientific study of the characteristics of each of their clays and which was always at the disposal of customers.

The directors contemplated, at an early date, the issue of 400,000 5½ per cent. cumulative preference shares of £1 each, having a priority over existing preference shares. The amount they would receive from this issue was somewhat more than they would immediately require, and to that extent they would pay out more in dividend than they would receive in interest. He believed, however, that it was prudent for a trading company to invest, where possible, a certain sum in readily realisable securities outside the business, where it would be available if an emergency arose, or if a favourable opportunity presented itself of extending the business.

After three years' experience of amalgamation, they were convinced of the wisdom of the step they took. They find that, as compared with the days when they were three separate companies, they could achieve in combination a better product at a lower cost, and a fuller service to customers.

At subsequent meetings resolutions were unanimously passed increasing the capital by the creation of 400,000 5½ per cent. cumulative first preference shares of £1 each.

South African Chemical Notes

Cyanide Manufacture

Imperial Chemical Industries, Ltd., the suppliers of much of the cyanide used in South Africa, after investigating the possibility of making cyanide on the Witwatersrand have decided in favour of the African Explosives and Industries, Ltd., undertaking the manufacture of cyanide at the Modderfontein explosives factory. The technical advisers recommend the immediate erection of a pilot plant with a capacity of 500 tons, which is considered to be, both economically and technically, the most effective. In 1934 the value of cyanide imported into South Africa was over £400,000, and the consumption of cyanide by the mines for the year totalled 17,287,493 lb., valued at £467,519.

Salt Tests

The quality of South African salt has been tested exhaustively in the Government laboratory in Johannesburg, and it was found that some manufacturers who submitted samples were not giving proper attention to crystallisation. Salt has been put to increasing uses during recent years, especially as a basic raw material in industries, and those listed by the Government are: food preservation, dairy, hide and skin curing, the production of sodium and chlorine by electrolysis of fused sodium chloride, sodium carbonate, and bicarbonate, by Leblanc and ammonia soda processes; caustic soda, sodium sulphate and bisulphate for the glass industry, soaps and other sodium compounds, ceramic glazes, medicinal, water softeners, dye and chemical industries and bakeries.

New Uses for Wattle Bark

At present much of the material passing through the wattle bark extract factories and the sawmills in South Africa is wasted, but experiments now in progress are expected to find valuable uses for it. The amount of wattle bark grown in Natal is increasing, and South Africa's need for the by-products seems to be increasing. Wattles were first grown in Natal in 1887, and in recent years other parts of South Africa have planted similar trees, but Natal still remains the main producer. The industry probably has a great future, especially as it is hoped to develop the trade with Japan, where wattles are used for tanning. No definite arrangement has been made, but local growers anticipate being given a large proportion of the Japanese business.

British Association of Chemists

Micro-Methods in Criminal Investigation

THE use of micro-methods in criminal investigation were outlined in a lecture which Mr. W. Doran, M.Sc., A.I.C., delivered before the Liverpool Section of the British Association of Chemists on January 22.

After a short review of the history of finger-print classification, Mr. Doran discussed in detail the technique of routine recording of finger-prints and the methods of dealing with chance impressions upon incriminating objects at the scene of a crime. The various modifications of procedure with plastic prints, visible prints and latent prints were compared and the problems of "development" for purposes of photography and permanent fixation were outlined. The use of different powders, such as lampblack, graphite, white lead, chalk, plaster of paris, kaolin, aluminium, antimony, copper, dragon's blood, etc., according to circumstances, was described and mention was made of the rapid iodine vapour method of revealing latent prints on paper and the silver nitrate process for prints on linen. Micro-methods adapted to the examination of tools for traces and of bullet and cartridge-case markings were briefly indicated.

Personal Notes

MR. J. L. BIGGART, of Paisley, chemical manufacturer, left personal estate in Great Britain valued at £93,136.

MR. F. RANSOM, of Hitchin, chairman of William Ransom and Son, Ltd., manufacturing chemists, left £138,407.

SIR JOHN CADMAN, chairman of the Anglo-Iranian Oil Co., Ltd., has been appointed a member of the Post Office Advisory Council.

MR. A. H. HAMILTON, J.P., founder and chairman of Archibald H. Hamilton and Co., Ltd., paint and varnish manufacturers, Glasgow, died on February 2.

MR. R. FITZGERALD, who for many years was South Wales area manager, at Cardiff, of the Dunlop Rubber Co., died recently.

MR. C. T. COOPER, of Sussex, chemist, who died on April 14 last, left estate valued at £27,679 with net personalty £16,608.

MR. C. BRUCE GARDNER, M.I.Mech.E., has been elected chairman of the London Iron and Steel Exchange. He is also chairman of Sir W. G. Armstrong Whitworth and Co., Ltd.

MR. J. BRASS, of Barnsley, was presented with the medal of the Institution of Mining Engineers on January 20, in recognition of his distinguished services to the mining profession and industry.

DR. W. DAVIDSON, in a lecture at the Royal Technical College, Glasgow, on January 29, described the principal carbonising methods employed in the manufacture of metallurgical gas and low temperature coke.

SIR JAMES IRVINE, C.B.E., the Principal of St. Andrews University, is on his way to India, where he has been asked to co-operate with an advisory committee set up by the Government.

LORD RAYLEIGH, F.R.S., president of the Physical Society, has been elected chairman of the governing body of the Imperial College of Science and Technology from March 1 next. He succeeds Lord Linlithgow, the new Viceroy of India.

MR. W. A. MACGILLIVRAY, who has been works manager at Nobel's Regent Factory at Linlithgow since 1920, was on February 1 presented with a walnut wardrobe from the staff and employees on his retirement and the closing down of the factory.

MAJOR J. GREG has been appointed vice-chairman, and MR. T. N. BALLANTYNE and MR. W. H. B. HATTON joint managing directors of the Earl of Dudley's Round Oak Steel Works, Ltd., Brierly Hill, of which the Earl of Dudley is chairman.

PROFESSOR W. L. BRAGG is giving his course on "Atomic Arrangement in Alloys" in three instead of four lectures owing to the recent death of King George. The lecture on January 24 was cancelled, the first lecture was given on January 29, continuing on February 4 and 11, as previously announced.

MR. D. CARTER, M.Sc., assistant chief colourist to Imperial Chemical Industries (Dyestuffs Group) gave a lecture on "Some Uses of Synthetic Dyestuffs" to a joint meeting of the Midlands section of the Society of Dyers and Colourists and the Nottingham Branch of the Foremen Dyers' Guild on January 29.

DR. W. J. HUFF, of the engineering faculty, Johns Hopkins University, has been appointed chief chemist of the Explosives Division of the Bureau of Mines, Department of the Interior, Washington. Dr. Huff was a member of this division, in charge of chemical work at the Pittsburgh Station, after the war, and there carried on a number of researches, one of which, on the corrosion of firearms, led to the widespread introduction and use of present-day non-corrosive ammunition.

Continental Chemical Notes

Austria

ACCORDING TO A VIENNA REPORT plans are being considered for the manufacture of casein artificial wool on the basis of the Italian process.

France

IT IS PROPOSED TO RECOMMENCE WORKING the tungsten ore deposits at Puy-les-Vignes, near Saint Leonard (Haute-Vienne) which have not been worked since 1916.

Holland

ERECTION OF THE RECENTLY ANNOUNCED FACTORY to be located at Delft for the manufacture of hydrochloric acid and other products will be undertaken by a new company in which the N. V. Lijmen-Gelatinefabriek "Delft" and the Billiton concern will participate.

High-Melting Metallic Oxides

Their Advantages for Laboratory Ware

PROPERTIES of high-melting metallic oxides and their advantages for chemical laboratory ware are discussed by Dr. E. Ryschkewitsch in "Chemische Fabrik" (January 7). Oxides of interest in this connection include those of beryllium, zirconium, magnesium and thorium.

Beryllium oxide closely resembles aluminium oxide in many chemical properties but is notable for its high melting point (over 2,000° C.) and its superior resistance to reducing agents. On the other hand, its basicity is higher than that of the aluminium compound which renders it more liable to attack by acidic substances although the contrary is naturally the case when alkaline fusions require to be carried out. Beryllium oxide possesses an exceptionally high electrical resistance which renders it eminently suitable as a support for heating coils.

With a melting point in the neighbourhood of 2,700° C. and excellent resistance both towards acids and alkalies, zirconium oxide is another important constructional material. The chemically pure oxide cannot, however, be processed by the usual ceramic methods owing to the allotropic change about 1,000° C. accompanied by considerable alteration in the specific volume of the material. This defect can be overcome by incorporating a small proportion of oxides with low molecular volumes, notably magnesium oxide and beryllium oxide. Crucibles composed of zirconium dioxide can be used up to a temperature of 2,000° C. for fusing a wide range of glasses, slags and minerals especially those with an acidic reaction.

A still higher melting point is possessed by magnesium oxide (2,800° C.) and stoneware prepared from the pure fused oxide resists the most drastic thermal strains. Fused magnesia crucibles have proved satisfactory in the melting of both precious and non-precious metals.

Thorium oxide is distinguished by the highest melting point of all known oxides (3,000° C.). Apparatus prepared from the pure substance has recently come into use in estimating the melting point of metals of the platinum group. In general, thorium oxide apparatus can be used in all cases where very high temperatures are applied in the absence of carbon, the very low vapour pressure of the oxide being an appreciable advantage for high temperature vacuum experiments.

THERE are three producers of carbon dioxide in Bulgaria, all using the coke process with a total annual capacity of 2,000 tons. The largest, "Vaglodvokis S.A.," Sofia, produces about 150 tons of liquid carbon dioxide annually. It is understood to have an installation for production of 1,000 tons annually of solid carbon dioxide. There are two smaller producers, namely, Fabrika Natcheff, S.A., at Rousse, and Zaharna Fabrika, at Gorna-Orehovitza.

New Dyestuffs

A New Caledon Jade Green

CALEDON JADE GREEN 4GS, a new product of Imperial Chemical Industries, Ltd., is a hot-dyeing yellowish green, suitable for dyeing all classes of cotton goods in machines or in the open beck. The light fastness of the new product is sufficiently good to warrant its use for curtain materials, whilst the general fastness properties are of the standard normally associated with the name "Caledon Jade Green."

Blue Grey Shades of Good Fastness

Chlorazol Fast Grey 2GS is a direct cotton dyestuff suitable for application to all types of cotton and viscose materials and produces a bluish grey shade of very good light fastness. It is of value for the dyeing of the cheaper type of casement materials, voiles, crêpes, velvets, cords, tapestries, chenilles, lining and raincoat materials and hatting ribbons. It is also suitable for filling in the cotton in cotton-wool union materials, from a low temperature dyebath. Chlorazol Fast Grey 2GS, moreover, is suitable for application to weighted and unweighted silk from an acid dyebath and produces a bluish grey shade of good fastness to water and light and of fairly good fastness to washing. Possessing very good solubility and level dyeing properties, it can be used in all types of circulating dyeing machines and is a useful component for the production of fast to light olives, drabs and browns. This new dyestuff is not of general interest for the direct printing of cotton, viscose and natural silk materials, but is suitable for the dyeing of ground shades for subsequent discharging with Formosul.

A Brilliant Blue of Excellent Affinity

Duranol Brilliant Blue BS is of particular interest on account of its brilliant shade, excellent building-up properties and very good light and general fastness properties. It possesses excellent level dyeing and penetrating properties and is suitable for dyeing all forms of acetate silk materials. Duranol Brilliant Blue BS is of particular interest as a component in mixtures, e.g., navy blues, where by virtue of its excellent affinity, full shades of very good fastness are readily obtainable. This new product can be used in conjunction with other dyestuffs for application to mixed fabrics containing acetate silk as it is unaffected by acids, alkalies, salt, etc., that may be necessary in the dyebath. Duranol Brilliant Blue BS, moreover, is suitable for the direct printing of acetate silk and acetate silk-natural silk union materials, and produces very deep shades which show no marking off on to adjacent material during steaming.

Chemical and Allied Stocks and Shares

THERE has again been active business in the industrial section of the Stock Exchange, and in many cases prices have moved further in favour of holders on balance for the week. Imperial Chemical have held most of their recent improvement. On the basis of last year's 8 per cent. dividend, which the market is continuing to anticipate will be maintained, the yield is nearly 4¼ per cent., which is rather larger than that on many other prominent industrial shares. This is because the general view is that the possibility of any large advance in the company's profits are bound up rather closely with international trade conditions in view of the wide ramifications of the business. Nevertheless the shares are being classed as probably moderately valued at the present time. B. Laporte have remained steady, aided by the directors' recent statement that it is hoped the dividend will again be brought up to 20 per cent. British Oxygen were steady, having remained under the influence of the recently-announced bonus. The market expects that although the additional shares will rank for the final dividend, the total dividend for the year will also be maintained in this case. In some quarters a larger payment than 15 per cent. is considered quite likely. Fison, Packard & Prentice remained very firm and have continued to receive a good deal of attention on the belief that the current year's profits will probably benefit much more fully from the expansion of the business, and that a larger dividend is again likely. William Blythe 3s. ordinary shares maintained their recent improvement to 7s. 6d., estimates of an increased final dividend having persisted. British Cyanides also held their recent advance, while British Drug Houses came in for renewed attention on the possibility of a larger dividend for the year. Gas Light and Coke ordinary units were firm on the excellent impression created by the past year's results. United Molasses were rather lower, partly owing to an easier tendency in tanker freight rates, but there is still talk in the market that the resumption of interim dividend payments is possible in March. Distillers show little change. In this case the hopes that a larger dividend is in prospect is not unconnected with the belief that there has been further expansion in the industrial alcohol side of the business, and that, as a result of the scope for the growth of this the directors may decide to follow a more liberal dividend policy. It is said that the registration of the Blythe Colour Works may be followed by a public issue of shares by the company before long. An offer for sale of 75,000 5½ per cent. cumulative preference shares of £1 each was made at 23s. per share this week by William Butler and Co. (Bristol). Apart from the distilling of coal tar the company produces benzol, disinfectants, sheep dips, insecticides and other products, and it also imports petroleum products, rosins and turpentine. The prospectus showed that the dividend requirements of the preference shares are covered five times over on the basis of the average profits for the past five years. Reckitt and Sons ordinary shares have maintained their good advance of the previous week, expectations of another total dividend of 22½ per cent. having continued. On the market there are also said to be possibilities of an eventual share bonus. International Nickel were not much affected by the absence of an increase in the quarterly dividend, although the market had been expecting a higher payment. It remains confident of a favourable increase in the total dividend for the year. Leading oil shares were again active at higher prices.

Name.	Feb. 4.	Jan. 27.
Anglo-Iranian Oil Co., Ltd. Ord.	92/6	84/4½
,, 8% Cum. Pref.	36/9	36/9
,, 9% Cum. Pref.	37/9	38/-
Associated Dyers and Cleaners, Ltd. Ord.	1/10½	1/10½
,, 6½% Cum. Pref.	5/6¾	5/6¾
Associated Portland Cement Manufacturers, Ltd. Ord.	72/6	72/6
,, 5½% Cum. Pref.	28/-	28/-
Benzol & By-Products, Ltd. 6% Cum. Part Pref.	2/6	2/6
Berger (Lewis) & Sons, Ltd. Ord.	66/10½	67/6
Bleachers' Association, Ltd. Ord.	7/6	7/6
,, 5½% Cum. Pref.	12/6	11/3
Boake, A., Roberts & Co., Ltd. 5% Pref. (Cum.)	20/-	20/-
Boots Pure Drug Co., Ltd. Ord. (5/-)	55/6	55/3
Borax Consolidated, Ltd., Pfd. Ord. (£)	110/-	110/-
,, Defd. Ord.	22/6	21/3
,, 5½% Cum. Pref. (£10)	£11/15/-	£11/15/-
,, 4½% Deb. (1st Mort.) Red. (£100)	£107	£107
,, 4½% 2nd Mort. Deb. Red. (£100)	£104/10/-	£103/10/-

Name.	Feb. 4.	Jan. 27.
Bradford Dyers' Association, Ltd. Ord.	9/4½	9/4½
,, 5% Cum. Pref.	13/9	12/6
,, 4% 1st Mort. Perp. Deb. (£100)	£87/10/-	£87/10/-
British Celanese, Ltd. 7% 1st Cum. Pfd.	25/3	25/3
,, 7½% Part. 2nd Cum. Pref.	23/-	23/6
British Cotton & Wool Dyers' Association Ltd. Ord. (5/-)	6/3	6/3
,, 4% 1st Mort. Deb. Red. (£100)	£96	£96
British Cyanide Co., Ltd. Ord. (2/-)	3/10½	3/6
British Drug Houses, Ltd. Ord.	18/1½	18/1½
,, 5% Cum. Pref.	21/10½	21/10½
British Glues and Chemicals, Ltd. Ord. (4/-)	8/1½	8/1½
,, 8% Pref. (Cum. and Part.)	28/9	28/9
British Oil and Cake Mills, Ltd. Cum. Pfd. Ord.	48/9	48/9
,, 5½% Cum. Pref.	25/7½	25/7½
,, 4½% First Mort. Deb. Red. (£100)	£107/10/-	£107/10/-
British Oxygen Co., Ltd. Ord.	123/9	126/3
,, 6½% Cum. Pref.	32/6	32/6

Name.	Feb. 4.	Jan. 27.
British Portland Cement Manufacturers, Ltd. Ord.	87/6	87/6
,, 6% Cum. Pref.	30/6	30/6
Bryant & May, Ltd. Pref.	66/3	66/3
Burt, Boulton & Haywood, Ltd. Ord.	20/-	20/-
,, 7% Cum. Pref.	27/6	27/6
,, 6% 1st Mort. Deb. Red. (£100)	£102/10/-	£102/10/-
Bush, W. J., & Co., Ltd. 5% Cum. Pref. (£5)	112/6	112/6
,, 4% 1st Mort. Deb. Red. (£100)	£96/10/-	£96/10/-
Calico Printers' Association, Ltd. Ord.	9/4½	9/4½
,, 5% Pref. (Cum.)	16/3	14/8¼
Cellulose, Acetate Silk Co., Ltd. Ord.	14/8½	14/8¼
,, Deferred (1/-)	2/10½	2/10½
Consett Iron Co., Ltd. Ord.	11/6	11/3
,, 8% Pref.	31/3	31/3
,, 6% First Deb. stock, Red. (£100)	£108/10/-	£108/10/-
Cooper, McDougal & Robertson, Ltd. Ord.	38/9	40/-
,, 7% Cum. Pref.	30/-	30/-
Courtaulds, Ltd. Ord.	59/4½	60/-
,, 5% Cum.	26/3	26/3
Crosfield, Joseph, & Sons, Ltd. 5% Cum. Pre Pref.	25/-	25/-
,, Cum. 6% Pref.	28/9	28/9
,, 6½% Cum. Pref.	31/10½	31/10½
,, 7½% "A" Cum. Pref.	30/-	30/-
Distillers Co., Ltd. Ord.	99/6	99/-
,, 6% Pref. Stock Cum.	31/9	31/6
Dorman Long & Co., Ltd. Ord.	20/9	20/9
,, Pref. Ord.	32/6	32/6
,, 6½% Non-Cum. 1st Pref.	23/3	23/3
,, 8% Non-Cum. 2nd Pref.	24/-	24/-
,, 4% First Mort. Perp. Deb. (£100)	£103/10/-	£103/10/-
,, 5% 1st Mort. Red. Deb. (£100)	£105/10/-	£105/10/-
English Velvet & Cord Dyers' Association Ltd. Ord.	4/4½	4/4½
,, 5% Cum. Pref.	8/9	8/9
,, 4% First Mort. Deb. Red. (£100)	£72/10/-	£72/10/-
Fison, Packard & Prentice, Ltd. Ord.	46/3	45/7½
,, 7% Non-Cum. Pref.	31/3	31/3
,, 4½% Debs. (Reg.) Red. (£100)	£106	£106
Gas Light & Coke Co., Ltd.	27/9	27/6
,, 3½% Maximum Stock (£100)	£89/10/-	£90/10/-
,, 4% Consolidated Pref. Stock (£100)	£108/10/-	£108/10/-
,, 3% Consolidated Deb. Stock, Irred. (£100)	£91/10/-	£91/10/-
,, 5% Deb. Stock Red. (£100)	£118/10/-	£117/10/-
,, 4½% Red. Deb. Stock (1960-65) (£100)	£115/10/-	£114/10/-
Goodlass Wall & Lead Industries, Ltd. Ord. (10/-)	15/-	15/-
,, 7% Prefd. Ord. (10/-)	13/9	13/9
,, 7% Cum. Pref.	30/-	28/9
Gossage, William, & Sons, Ltd. 5% 1st Cum. Pref.	24/4½	24/4½
,, 6½% Cum. Pref.	28/9	28/9
Imperial Chemical Industries, Ltd. Ord.	37/6	37/9
,, Deferred (10/-)	9/-	9/3
,, 7% Cum. Pref.	34/-	34/-
Imperial Smelting Corporation, Ltd. Ord.	15/6	15/6
,, 6½% Pref. (Cum.)	25/7½	25/7½
International Nickel Co. of Canada, Ltd. Cum.	$48¾	$49½
Johnson, Matthey & Co., Ltd. 5% Cum. Pref. (£5)	105/-	105/-
,, 4% Mort. Deb. Red. (£100)	£98/10/-	£98/10/-
Laporte, B., Ltd. Ord.	130/-	130/-
Lawes Chemical Co., Ltd. Ord. (1/-)	6/3	6/3
,, 7% Non-Cum. Part Pref. (10/-)	10/-	10/-
Lever Bros., Ltd. 7% Cum. Pref.	33/-	33/-
,, 8% Cum. "A" Pref.	33/9	33/9
,, 20% Cum. Prefd. Ord.	80/-	80/-
,, 5% Cons. Deb. (£100)	£108/10/-	£108/10/-
,, 4% Cons. Deb. (£100)	£106/10/-	£106/10/-
Magadi Soda Co., Ltd. 12½% Pref. Ord. (5/-)	1/3	1/3
,, 6% 2nd Pref. (5/-)	6d.	6d.
,, 6% 1st Debs. (Reg.)	£40	£40
Major & Co., Ltd. Ord. (5/-)	7½d.	7½d.
,, 8% Part. Prefd. Ord. (10/-)	9d.	9d.
,, 7½% Cum. Pref.	1/6¾	1/6¾
Pinchin, Johnson & Co., Ltd. Ord. (10/-)	45/-	44/-
,, 1st Pref. 6½% Cum.	32/-	32/-
Potash Syndicate of Germany (Deutsches Kalisyndikat G.m.b.H.) 7% Gld. Ln. Sr. "A" and "B" Rd.	£73	£72
Reckitt & Sons, Ltd. Ord.	118/9	118/9
,, 4½% Cum. 1st Pref.	24/4½	24/4½
Salt Union, Ltd. Ord.	47/6	47/6
,, Pref.	47/6	47/6
,, 4½% Deb. (£100)	£107/10/-	£107/10/-
South Metropolitan Gas Co. Ord. (£100)	£132/10/-	£134/10/-
,, 6% Irred. Pref. (£100)	£149/10/-	£150/10/-
,, 4% Pref. (Irred.) (£100)	£105	£107
,, Perpetual 3% Deb. (£100)	£89/10/-	£88/10/-
,, 5% Red. Deb. 1950-60 (£100)	£114/10/-	£114/10/-
Staveley Coal and Iron Co., Ltd. Ord.	53/9	41/3
Stevenson & Howell, Ltd. 6½% Cum. Pref.	26/3	26/3
Triplex Safety Glass Co., Ltd. Ord. (10/-)	90/7½	90/7½
Unilevers, Ltd. Ord.	33/9	32/6
,, 7% Cum. Pref.	31/9	30/9
United Glass Bottle Manufacturers, Ltd. Ord.	42/6	42/6
,, 7½% Cum. Pref.	32/6	32/6
United Molasses Co., Ltd. Ord. (6/8)	26/3	27/6
,, 6% Cum. Pref.	26/3	26/3
United Premier Oil & Cake Co., Ltd. Ord. (5/-)	10/6	10/9
,, 7% Cum. Pref.	25/-	25/-
,, 4¾% Deb. Red. (£100)	£101/10/-	£101/10/-

Inventions in the Chemical Industry

Patent Specifications and Applications

The following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Specifications Open to Public Inspection

SULPHUR DIOXIDE from gases containing same, process for recovery.—Metallges. A.-G. July 20, 1934. 7324/35.

HYDROCARBON OILS, separation of waxy constituents.—Standard Oil Development Co. July 14, 1934. 14106/35.

CRACKED GASOLINE having low gum content, process for production.—Naamlooze Vennootschap Nieuwe Octrooi Maatschappij. July 17, 1934. 16507/35.

MORPHOLINE VINYL ETHERS and related compounds, production. Carbide and Carbon Chemicals Corporation. July 19, 1934. 18381/35.

OXIDATION OF MERCAPTANS, process.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. July 14, 1934. 19160/35.

MONOAZO DYESTUFFS, manufacture.—I. G. Farbenindustrie. July 14, 1934.—19997/35.

STELLITE-LIKE COBALT-CHROMIUM ALLOYS, manufacture.—Heraeus Vacuumschmelze A.-G. July 14, 1934. 20084/35.

CHROMABLE AZO DYESTUFFS of the pyrazolone series, manufacture.—Chemical Works, formerly Sandoz. July 17, 1934. 20272/35.

VINYL ESTERS, manufacture.—I. G. Farbenindustrie. July 17, 1934. 20879/35.

AZO DYESTUFFS, process for manufacture.—Chemical Works, formerly Sandoz. July 18, 1934. 20409/35.

TITANIUM PIGMENTS, production.—British Titan Products Co., Ltd. July 19, 1934. 20484/35.

INDIGOID DYESTUFFS OF THE PYRENE SERIES, manufacture.—I. G. Farbenindustrie. July 18, 1934. 20491/35.

INTERMEDIATES AND AZO DYESTUFFS derived therefrom, manufacture.—E. I. du Pont de Nemours and Co. July 18, 1934. 20512/35.

PROCESS FOR TREATING THE PRODUCTS of the synthesis of benzine from hydrogen and the oxides of carbon.—Studien-und Verwertungs G. July 19, 1934. 20648/35.

SOLID STABLE SULPHURIC ACID ESTER SALTS of leuco-vat dyestuffs, Manufacture.—Durand and Huguenin A.-G. July 21, 1934. 20803/35.

N-(AMINOALKYL)-ANTHRANILIC ACID ALKYL ESTERS, manufacture. I. G. Farbenindustrie. July 26, 1934. 21162/35.

AMINO-CARBOXYLIC ACID NITRILES and amino-carboxylic acids, manufacture.—I. G. Farbenindustrie. July 26, 1934. 21285/35.

ORGANIC FLUORINE COMPOUNDS.—British Thomson-Houston Co., Ltd. July 28, 1934. 21513/35.

Specifications Accepted with Date of Application

STABLE DIAZO SALT PREPARATIONS, manufacture.—I. G. Farbenindustrie. July 13, 1933. 441,085.

MONOAZO DYESTUFFS, manufacture.—Imperial Chemical Industries, Ltd., and A. H. Knight. July 13, 1934. 441,089.

DISAZO DYESTUFFS, manufacture and production.—Coutts and Co. and F. Johnson (legal representatives of J. Y. Johnson (deceased)) (I. G. Farbenindustrie). July 23, 1934. 441,091.

WAXES, process for manufacture.—H. T. Böhme A.-G. Nov. 18, 1933. 441,096.

OCTYLPHENOLS AND ETHERS thereof, process for manufacture.—Röhm and Haas Co. Nov. 14, 1933. 440,910.

LUBRICATING OILS and process for preparing.—Resinous Products and Chemical Co. Dec. 20, 1933. 440,916.

DYESTUFFS and intermediate products, manufacture.—Soc. of Chemical Industry in Basle. March 17, 1934. 441,041

SYNTHETIC RESINS.—British Thomson-Houston Co., Ltd. March 23, 1934. 440,924.

N-SUBSTITUTION PRODUCTS of 1.4-diamino-anthraquinones, manufacture and production.—I. G. Farbenindustrie. Sept. 15, 1934. 441,043.

POLYSTYROL OF MIXTURES OF POLYSTYROL BODIES formed with other substances.—Siemens and Halske A.-G. April 6, 1934. 440,926.

ESTERS OF GLYCOL ETHERS and compositions containing the same. Carbide and Carbon Chemicals Corporation. May 4, 1934. 440,986.

SEPARATING NON-LUBRICATING HYDROCARBON OILS into their components, process.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. July 15, 1933. 441,104.

RECOVERY OF TIN from stanniferous materials such as stanniferous scrap metal.—T. Goldschmidt A.-G. May 7, 1934. 440,930.

SEPARATING LUBRICATING HYDROCARBON OILS into their components.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. July 15, 1933. 441,105.

CONVERSION OF POTASSIUM CHLORIDE OF potassium fertiliser salts into sintered masses.—Kali-Forschungs-Anstalt Ges. July 7, 1934. 440,991.

VAT DYESTUFFS, manufacture.—I. G. Farbenindustrie. July 4, 1934. 441,049.

ALCOHOLS containing more than four carbon atoms, process for manufacture.—Chemical Works, formerly Sandoz. July 7, 1934. 440,934.

FILTERING MASSES for gas masks for affording protection against hydrocyanic acid.—Soc. Italiana Pirelli. Sept. 18, 1934. 440,943.

COMPLEX CALCIUM MAGNESIUM PHOSPHATES capable of being used as fertilisers, method for manufacture.—T. Schmidt. June 11, 1934. 441,197.

ACRIDINE DERIVATIVES, process for manufacture.—I. G. Farbenindustrie, Dr. F. Mietzsch and Dr. H. Mauss. July 5, 1934. 441,132.

CONVERSION OF UNSATURATED ALCOHOLS and/or ethers into saturated aldehydes and/or ketones.—Naamlooze Vennotschap de Bataafsche Petroleum Maatschappij. July 17, 1933. 441,334.

HYDROCARBON OILS and their components, process for separating.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. July 15, 1933. 441,136.

METAL OXIDES COLLOIDALLY SOLUBLE IN WATER, manufacture and production.—I. G. Farbenindustrie. July 15, 1933. 441,384.

DYESTUFFS, manufacture and production.—Coutts and Co. and F. Johnson (I. G. Farbenindustrie). July 19, 1934. 441,389.

NITRILES, manufacture.—Imperial Chemical Industries, Ltd., J. S. H. Davies and W. O. Jones. July 20, 1934. 441,399.

AZO DYESTUFFS, process for manufacture.—A. Carpmael (I. G. Farbenindustrie). July 20, 1934. 441,408.

PYRENE COMPOUNDS, process for manufacture.—A. Carpmael (I. G. Farbenindustrie).- July 20, 1934. 441,408.

ANTHRAQUINONE DYESTUFFS and process for their manufacture. Chemical Works, formerly Sandoz. Feb. 16, 1934. 441,412.

PRECIPITATED CALCIUM CARBONATE, production.—Union Chimique Belge, and J. Guillissen. Sept. 23, 1933. 441,223.

AZO DYESTUFFS, manufacture.—Soc. of Chemical Industry in Basle. April 19, 1934. 441,178.

NITROGENOUS CELLULOSE DERIVATIVES, process for manufacture. I. G. Farbenindustrie. Aug. 14, 1934. 441,448.

PETROLEUM HYDROCARBON OILS AND SPIRITS, methods and apparatus for treating.—J. F. Wait. April 19, 1934. 441,703.

QUATERNARY AMMONIUM COMPOUNDS and preserving and disinfecting media containing the same, manufacture.—A. Carpmael (I. G. Farbenindustrie). June 13, 1934. 441,473.

SAPONIFICATION OF ORGANIC ESTERS OF CELLULOSE.—H. Dreyfus. June 16, 1934. 441,544.

POLYPHOSPHATES, manufacture.—W. J. Tennant (Henkel and Cie, G.). June 19, 1934. 441,474.

ISOALLOXAZINE COMPOUNDS, process for the manufacture.—A. Carpmael (I. G. Farbenindustrie). July 20, 1934. 441,692.

HYDROCYANIC ACID, manufacture.—E. I. du Pont de Nemours and Co. July 21, 1933. 441,632.

DRY GLUES FROM DEXTRIN, production.—Jagenberg-Werke A.-G. Jan. 11, 1934. 441,658.

POLYMETHINE DYESTUFFS AND INTERMEDIATE PRODUCTS, manufacture and application.—I. G. Farbenindustrie. July 21, 1933. 441,624.

CRYSTALLISED AMMONIUM NITRATE with utilisation of the reaction heat for the evaporation of water, process of producing.—Bamag-Meguin A.-G. Feb. 24, 1934. 441,586.

SULPHUR CONTAINED IN BENZOLS, continuous process and apparatus for the elimination by physical means.—Soc. des Etablissements Barbet. March 10, 1934. 441,518.

δ-TRANS-π-OXOCAMPHOR FROM ISO-KETOPINIC ACID, process for preparing.—Y. Asahina and M. Ishidate. April 1, 1935. 441,807.

BERYLLIUM ALLOYS, manufacture.—Beryllium Corporation. June 26, 1934. 441,532.

METALLIC SODIUM, method of manufacturing.—R. Hara and S. Abe. July 20, 1935. 441,753.

WATER-SOLUBLE ORGANIC SULPHO COMPOUNDS, manufacture.—Deutsche Hydrierwerke A.-G. July 20, 1933. 441,601.

Applications for Patents

(January 16 to 22 inclusive.)

GASEOUS OLEFINES, polymerisation.—Anglo-Iranian Oil Co., Ltd., and A. E. Dunston. 1919.

SULPHONIC ACIDS, manufacture.—A. Carpmael (I. G. Farbenindustrie). 1617.

ACID AMINOTRIARYLMETHANE DYESTUFFS, manufacture.—A. Carpmael (I. G. Farbenindustrie). 1857.

POLYMERISATION PRODUCTS, manufacture.—Chemische Forschungsges. (Germany, Jan. 19, '35.) 1691.

HARD WAX, ETC., CONDENSATION PRODUCTS, manufacture.—Deutsche Hydrierwerke A.-G. (Germany, Jan. 16, '35.) 1472.

LEUKO ESTERS OF VAT DYESTUFFS, developing.—F. Farrington, C. F. Parker, C. L. Wall and J. Hardcastle & Co., Ltd. 1515.

AZO-DYESTUFFS SOLUBLE IN WATER, manufacture.—W. W. Groves (I. G. Farbenindustrie). 1439.

ANILINE DERIVATIVES, manufacture.—N. H. Haddock and Imperial Chemical Industries, Ltd. 1619.

ANTHRAQUINONE DYESTUFFS.—N. H. Haddock, F. Lodge and Imperial Chemical Industries, Ltd. 2066, 2067.

ARSENOBENZENE-MONOSULPHOXYLATES, manufacture.—I. G. Farbneindustrie. (Germany, April 3, '35.) 2053.

AZO DYESTUFFS.—Imperial Chemical Industries, Ltd., and A. H. Knight. 1618, 1826.

HOMOLOGUES OF METHANE, splitting.—G. W. Johnson (I. G. Farbenindustrie). 1431.

LOW AROMATIC HYDROCARBONS, in particular benzine and toluene, from mineral coals by destructive hydrogenation, manufacture.—G. W. Johnson (I. G. Farbenindustrie). 2031.

CARBON DIOXIDE FROM GASES, removal and recovery.—D. W. Parkes and Robinson Bros., Ltd. 1848.

ACIDITY OF GASES, apparatus for measuring.—South Metropolitan Gas Co. 1584.

(January 23 to 29 inclusive.)

ZINC OXIDE.—Amalgamated Oxides, Ltd., and L. O. Kekwick. 2651.

HYDROCYANIC ACID, manufacture.—E. P. Bartlett and E. I. du Pont de Nemours and Co. 2557.

ELECTRO-CHEMICAL REDUCTIONS AND OXIDATIONS, process for effecting.—E. Berl. 2672.

LOWER SUBSTITUTED CELLULOSE ESTERS by means of organic fatty acids, manufactures.—E. Berl. 2673.

CELLULOSE ETHERS AND ESTERS, manufacture of products containing.—E. Berl. 2674.

NITRATES OF CARBOHYDRATES, stabilisation.—E. Berl. 2675.

NITRATES OF CARBOHYDRATES, manufacture.—E. Berl. 2678.

1 : 2 : 3 : 4-TETRAHYDROQUINOLINE SERIES, manufacture of derivatives.—A. G. Bloxam (H. Rupe). 2293.

SUBSTITUTED BARBITURIC ACIDS.—F. Boedecker, J. D. Riedel-E. de Haen, A.-G., and H. Gruber. 2315.

FLUOROHYDROCARBONS, manufacture.—A. Carpmael (I. G. Farbenindustrie). 2358.

POLYAZO DYESTUFFS, manufacture.—A. Carpmael (I. G. Farbenindustrie). 2549.

GLYCOL DERIVATIVES, production.—Distillers Co., Ltd. 2312.

NITROCELLULOSE, manufacture.—Du Pont Viscoloid Co. (United States, March 2, '35.) 2367.

STABLE SOLUTIONS OF LEVO-ASCORBIC ACID or an analogue thereof, manufacture.—I. G. Farbenindustrie. (Germany, Jan. 26, '35.) 2532.

HYDROXYALKYL ALKYLENE DIAMINES, production.—I. G. Farbenindustrie. (Germany, Jan. 31, '35.) 2697.

POLYMERISED VINYL ESTER and products derived therefrom, manufacture.—Imperial Chemical Industries, Ltd., and H. J. Tattersall. 2741.

SULPHATES AND SULPHUR from gases, manufacture.—G. W. Johnson (I. G. Farbenindustrie). 2178.

ALPHA-BETA-UNSATURATED ACID AMIDES from ketones cyanhydrins, manufacture.—G. W. Johnson (I. G. Farbenindustrie). 2698.

GLYCOL DERIVATIVES, production.—G. Minkoff, J. E. Youell and H. M. Stanley. 2312.

UNSATURATED AND/OR AROMATIC ORGANIC COMPOUNDS, manufacture of valuable products.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. (Holland, Feb. 16, '35.) 2410.

Weekly Prices of British Chemical Products

THERE are no price changes to report in the markets for general heavy chemicals, rubber chemicals, wood distillation products, pharmaceutical and photographic chemicals, perfumery chemicals, essential oils and intermediates. In the coal tar products market there have been slight reductions in the prices of naphthalene (purified crystals) and pyridine, 90/140.

LONDON.—Chemical markets have continued on quietly steady lines, there being no change in prices to report. Demand continues of fair volume.

MANCHESTER.—From the point of actual new business conditions on the Manchester chemical market during the past week have been extremely patchy, and a number of sellers, although they have relatively little of which to complain so far as the volume of deliveries against existing contracts is concerned, have reported comparatively little new buying this week. The bulk of the orders that have found their way on to the books have been for no more than moderate qualities. A good deal of interest has been aroused by this week's announcement of the removal of the import duty on oxalic acid, but, up to the time of writing, it has had no influence on the price position here, and it is by no means certain that it will. With regard to the by-products market values with one or two exceptions are being maintained and business is fairly active. The scarcity of supplies in several sections is still extremely marked.

SCOTLAND.—There has been a slight improvement in the demand for chemicals for home trade during the week, though export business still remains limited. Prices generally continue steady, with no important changes to report.

General Chemicals

ACETONE.—LONDON: £62 to £65 per ton; SCOTLAND: £66 to £68 ex wharf, according to quantity.

ACID, ACETIC.—40% technical, £17 15s. per ton. LONDON: Tech., 80%, £33 5s. to £35 5s. per ton; pure 80%, £35 5s. to £37 5s.; tech., 40%, £17 15s. to £19 15s.; tech., 60%, £25 15s. to £27 15s. SCOTLAND: Glacial 98/100%, £48 to £52; pure 80%, £39 5s.; tech., 80%, £38 5s., d/d buyers' premises Great Britain. MANCHESTER: 80%, commercial, £37 5s.; tech. glacial, £50.

ACID, BORIC.—Commercial granulated, £27 per ton; crystal, £28; powdered, £29; extra finely powdered, £31; packed in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. B.P. cryst., £36; B.P. powder, £37. SCOTLAND: Crystals, £28; powdered, £29.

ACID, CHROMIC.—10½d. per lb., less 2½%, d/d U.K.

ACID, CITRIC.—11¾d. per lb. MANCHESTER: 11¼d. to 1s. SCOTLAND: 11¾d.

ACID, CRESYLIC.—97/100%, 1s. 5d. to 1s. 6d. per gal.; 99/100%, refined, 1s. 9d. to 1s. 10d. per gal. LONDON: 98/100%, 1s. 5d. f.o.r.; dark, 1s.

ACID, FORMIC.—LONDON: £42 to £47 per ton.

ACID, HYDROCHLORIC.—Spot, 4s. to 6s. carboy d/d according to purity, strength and locality. SCOTLAND: Arsenical quality, 4s.; dearsenicated, 5s. ex works, full wagon loads.

ACID, LACTIC.—LANCASHIRE: Dark tech., 50% by vol., £24 10s. per ton; 50% by weight, £28 10s.; 80% by weight, £50; pale tech., 50% by vol., £28; 50% by weight, £33; 80% by weight, £55; edible, 50% by vol., £41. One-ton lots ex works, barrels free.

ACID, NITRIC.—80° Tw. spot, £18 to £25 per ton makers' works. SCOTLAND: 80°, £24 ex station full truck loads.

ACID, OXALIC.—LONDON: £47 17s. 6d. to £57 10s. per ton, according to packages and position. SCOTLAND: 98/100%, £48 to £50 ex store. MANCHESTER: £49 to £54 ex store.

ACID, SULPHURIC.—SCOTLAND: 144° quality, £3 12s. 6d.; 168°, £7; dearsenicated, 20s. per ton extra.

ACID, TARTARIC.—1s. per lb. less 5%, carriage paid for lots of 5 cwt. and upwards. LONDON: 11½d., less 5%. SCOTLAND: 1s. 0¼d. less 5%. MANCHESTER: 1s. per lb.

ALUM.—SCOTLAND: Lump potash, £8 10s. per ton ex store

ALUMINA SULPHATE.—LONDON: £7 10s. to £8 per ton. SCOTLAND: £7 to £8 ex store.

AMMONIA, ANHYDROUS.—Spot, 10d. per lb. d/d in cylinders. SCOTLAND: 10d. to 1s. containers extra and returnable.

AMMONIA, LIQUID.—SCOTLAND: 80°, 2½d. to 3d. per lb., d/d.

AMMONIUM BICHROMATE.—8d. per lb. d/d U.K.

AMMONIUM CARBONATE.—SCOTLAND: Lump, £30 per ton; powdered, £33, in 5-cwt. casks d/d buyers' premises U.K.

AMMONIUM CHLORIDE.—LONDON: Fine white crystals, £18 to £19. (See also Salammoniac.)

AMMONIUM CHLORIDE (MURIATE).—SCOTLAND: British dog tooth crystals, £32 to £35 per ton carriage paid according to quantity. (See also Salammoniac.)

AMMONIUM SULPHATE.—Neutral quality, 20.6% nitrogen, £7 per ton.

ANTIMONY OXIDE.—SCOTLAND: £61 to £65 per ton, c.i.f. U.K. ports.

ANTIMONY SULPHIDE.—Golden, 6½d. to 1s. 1d. per lb.; crimson, 1s. 5½d. to 1s. 7d. per lb., according to quality.

ARSENIC.—LONDON: £15 per ton c.i.f. main U.K. ports for imported material; Cornish nominal, £22 10s. f.o.r. mines. SCOTLAND: White powdered, £23 ex wharf. MANCHESTER: White powdered Cornish, £21, ex store.

ARSENIC SULPHIDE.—Yellow, 1s. 5d. to 1s. 7d. per lb.

BARIUM CHLORIDE.—LONDON: £10 10s. per ton. SCOTLAND: £10 10s. to £10 15s.

BARYTES.—£6 10s. to £8 per ton.

BISULPHITE OF LIME.—£6 10s. per ton f.o.r. London.

BLEACHING POWDER.—Spot, 35/37%, £7 19s. per ton d/d station in casks, special terms for contract. SCOTLAND: £9 5s.

BORAX, COMMERCIAL.—Granulated, £14 10s. per ton; crystal, £15 10s.; powdered, £16; finely powdered, £17; packed in 1-cwt. bags, carriage paid home to buyer's premises within the United Kingdom in 1-ton lots.

CADMIUM SULPHIDE.—5s. to 5s. 3d.

CALCIUM CHLORIDE.—Solid 70/75% spot, £5 5s. per ton d/d station in drums.

CARBON BISULPHIDE.—£31 to £33 per ton, drums extra.

CARBON BLACK.—3¾d. to 4¼d. per lb. LONDON: 4¼d. to 5d.

CARBON TETRACHLORIDE.—SCOTLAND: £41 to £43 per ton, drums extra.

CHROMIUM OXIDE.—10¾d. per lb., according to quantity d/d U.K.; green, 1s. 2d. per lb.

CHROMETAN.—Crystals, 3¼d. per lb.; liquor, £19 10s. per ton d/d.

COPPERAS (GREEN).—SCOTLAND: £3 15s. per ton, f.o.r. or ex works.

CREAM OF TARTAR.—£3 19s. per cwt. less 2½%. LONDON: £3 17s. per cwt. SCOTLAND: £3 16s. 6d. net.

DINITROTOLUENE.—66/68° C., 9d. per lb.

DIPHENYLGUANIDINE.—2s. 2d. per lb.

FORMALDEHYDE.—LONDON: £24 10s. per ton. SCOTLAND: 40%, £25 to £28 ex store.

IODINE.—Resublimed B.P., 6s. 3d. to 8s. 4d. per lb.

LAMPBLACK.—£45 to £48 per ton.

LEAD ACETATE.—LONDON: White, £36 10s. per ton; brown, £1 per ton less. SCOTLAND: White crystals, £34 to £35; brown, £1 per ton less. MANCHESTER: White, £36; brown, £35.

LEAD NITRATE.—£32 10s. to £34 10s. per ton.

LEAD, RED.—SCOTLAND: £25 to £27 per ton less 2½%; d/d buyer's works.

LEAD, WHITE.—SCOTLAND: £39 per ton, carriage paid. LONDON: £42 10s.

LITHOPONE.—30%, £16 10s. to £17 per ton.

MAGNESITE.—SCOTLAND: Ground calcined, £9 per ton, ex store.

MAGNESIUM CHLORIDE.—SCOTLAND: £7 per ton.

MAGNESIUM SULPHATE.—Commercial, £5 per ton, ex wharf.

METHYLATED SPIRIT.—61 O.P. industrial, 1s. 5d. to 2s. per gal.; pyridinised industrial, 1s. 7d. to 2s. 2d.; mineralised, 2s. 6d. to 3s. Spirit 64 O.P. is 1d. more in all cases and the range of prices is according to quantities. SCOTLAND: Industrial 64 O.P., 1s. 9d. to 2s. 4d.

PHENOL.—6¾d. to 7¼d. per lb. to June 30, 1936.

POTASH, CAUSTIC.—LONDON: £42 per ton. MANCHESTER: £38.

POTASSIUM BICHROMATE.—Crystals and Granular, 5d. per lb. less 5%, d/d U.K. Ground, 5¼d. LONDON: 5d. per lb. less 5%, with discounts for contracts. SCOTLAND: 5d. d/d U.K. or c.i.f. Irish Ports. MANCHESTER: 5d.

POTASSIUM CHLORATE.—LONDON: £37 to £40 per ton. SCOTLAND: 99¾/100%, powder, £37. MANCHESTER: £38.

POTASSIUM CHROMATE.—6¼d. per lb. d/d U.K.

POTASSIUM IODIDE.—B.P., 5s. 2d. per lb.

POTASSIUM NITRATE.—SCOTLAND: Refined granulated, £29 per ton c.i.f. U.K. ports. Spot, £30 per ton ex store.

POTASSIUM PERMANGANATE.—LONDON: 8¾d. per lb. SCOTLAND: B.P. crystals, 10d. to 10½d. MANCHESTER: B.P., 11½d.

POTASSIUM PRUSSIATES.—LONDON: Yellow, 8½d. per lb. SCOTLAND: Yellow spot, 8¼d. ex store. MANCHESTER: Yellow, 8¼d. to 8½d.

SALAMMONIAC.—First lump spot, £41 17s. 6d. per ton d/d in barrels. SCOTLAND: Large crystals, in casks, £36.

SODA ASH.—58% spot, £5 12s. 6d. per ton f.o.r. in bags.

SODA, CAUSTIC.—Solid, 76/77° spot, £13 17s. 6d. per ton d/d station. SCOTLAND: Powdered 98/99%, £17 10s. in drums, £18 5s. in casks, Solid 76/77°, £14 12s. 6d. in drums; 70/73%, £14 12s. 6d., carriage paid buyer's station, minimum 4-ton lots; contracts 10s. per ton less. MANCHESTER: £13 5s. to £14 contracts.

SODA CRYSTALS.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.

SODIUM ACETATE.—LONDON: £21 10s. SCOTLAND: £20 15s.

SODIUM BICARBONATE.—Refined spot, £10 10s. per ton d/d station in bags. SCOTLAND: Refined recrystallised £10 15s. ex quay or station. MANCHESTER: £10 10s.

SODIUM BICHROMATE.—Crystals cake and powder 4d. per lb. net d/d U.K. discount 5%. Anhydrous, 5d. per lb. LONDON:

4d. per lb. less 5% for spot lots and 4d. per lb. with discounts for contract quantities. MANCHESTER: 4d. per lb. basis. SCOTLAND: 4d. delivered buyer's premises with concession for contracts.

SODIUM BISULPHITE POWDER.—60/62%, £20 per ton d/d 1 cwt. iron drums for home trade.

SODIUM CARBONATE, MONOHYDRATE.—£15 per ton d/d in minimum ton lots in 2 cwt. free bags. Soda crystals, SCOTLAND: £5 to £5 5s. per ton ex quay or station. Powdered or pea quality, 7s. 6d. per ton extra. Light Soda Ash, £7 ex quay, min. 4-ton lots with reductions for contracts.

SODIUM CHLORATE.—£31 per ton. SCOTLAND: 3¾d. per lb.

SODIUM CHROMATE.—4d. per lb. d/d U.K.

SODIUM HYPOSULPHITE.—SCOTLAND: Large crystals English manufacture, £9 5s. per ton ex stations, min. 4-ton lots. Pea crystals, £14 10s. ex station, 4-ton lots. MANCHESTER: Commercial, £10 5s.; photographic, £14 10s.

SODIUM METASILICATE.—£14 per ton, d/d U.K. in cwt. bags.

SODIUM IODIDE.—B.P., 6s. per lb.

SODIUM NITRITE.—LONDON: Spot, £18 5s. to £20 5s. per ton d/d station in drums.

SODIUM PERBORATE.—10%, 9¼d. per lb. d/d in 1-cwt. drums. LONDON: 10d. per lb.

SODIUM PHOSPHATE.—£13 per ton.

SODIUM PRUSSIATE.—LONDON: 5d. to 5¼d. per lb. SCOTLAND: 5d. to 5⅜d. ex store. MANCHESTER: 5d. to 5¼d.

SODIUM SILICATE.—140° Tw. Spot, £8 per ton. SCOTLAND: £8 10s.

SODIUM SULPHATE (GLAUBER SALTS).—£4 2s. 6d. per ton d/d SCOTLAND: English material, £3 15s.

SODIUM SULPHATE (SALT CAKE).—Unground spot, £3 12s. 6d. per ton d/d station in bulk. SCOTLAND: Ground quality, £3 5s. per ton d/d. MANCHESTER: £3 5s.

SODIUM SULPHIDE.—Solid 60/62% Spot, £10 15s. per ton d/d in drums; crystals 30/32%, £8 per ton d/d in casks. SCOTLAND: For home consumption, Solid 60/62%, £10 5s.; broken 60/62%, £11 5s.; crystals, 30/32%, £8 7s. 6d., d/d buyer's works on contract, min. 4-ton lots. Spot solid, 5s. per ton extra. Crystals, 2s. 6d. per ton extra. MANCHESTER: Concentrated solid, 60/62%, £11; commercial, £8 2s. 6d.

SODIUM SULPHITE.—Pea crystals, spot, £13 10s. per ton d/d station in kegs. Commercial spot, £8 15s. d/d station in bags.

SULPHUR.—£9 10s. to £9 15s. per ton. SCOTLAND: £8 to £9.

SULPHATE OF COPPER.—Manchester: £14 15s. per ton f.o.b.

SULPHUR CHLORIDE.—5d. to 7d. per lb., according to quality.

SULPHUR PRECIP.—B.P., £55 to £60 per ton according to quantity. Commercial, £50 to £55.

VERMILION.—Pale or deep, 5s. 1d. per lb. in 1-cwt. lots.

ZINC CHLORIDE.—SCOTLAND: British material, 98%, £18 10s. per ton f.o.b. U.K. ports.

ZINZ SULPHATE.—LONDON: £12 per ton. SCOTLAND: £10 10s.

ZINC SULPHIDE.—10d. to 11d. per lb.

Coal Tar Products

ACID, CRESYLIC.—99/100%, 2s. to 2s. 9d. per gal., according to specification; pale 98%, 1s. 10d. to 1s. 11d.; dark, 1s. 6d. to 1s. 7d. LONDON: 98/100%, 1s. 4d.; dark, 95/97%, 1s. SCOTLAND: Pale, 99/100%, 1s. 3d. to 1s. 4d.; dark, 97/99%, 1s. to 1s 1d.; high boiling acid, 2s. 6d. to 3s.

ACID, CARBOLIC.—Crystals, 6¾d. to 7¼d. per lb.; crude, 60's, 1s. 11½d. to 2s. 2½d. per gal. MANCHESTER: Crystals, 7¼d. per lb.; crude, 2s. 2d. to 2s. 3d. per gal. SCOTLAND: 60's, 2s. 6d. to 2s. 7d.

BENZOL.—At works, crude, 9½d. to 10d. per gal.; standard motor 1s. 3d. to 1s. 3½d.; 90%, 1s. 4d. to 1s. 4½d.; pure, 1s. 7½d. to 1s. 8d. LONDON: Motor, 1s. 3½d. SCOTLAND: Motor, 1s. 6½d.

CREOSOTE.—B.S.I. Specification standard, 5½d. per gal. f.o.r. Home, 3¾d. d/d. LONDON: 4½d. f.o.r. North; 5d. London. MANCHESTER: 4¾d. to 5½d. SCOTLAND: Specification oils, 4d.; washed oil, 4½d. to 4¾d.; light, 4½d.; heavy, 4½d. to 4¾d.

NAPHTHA.—Solvent, 90/100%, 1s. 5½d. to 1s. 6½d. per gal.; 95/160%, 1s. 9d.; 90%, 11d. to 1s. 1d. LONDON: Solvent, 1s. 3½d. to 1s. 4d.; heavy, 11d. to 1s. 0½d. f.o.r. SCOTLAND: 90/160%, 1s. 3d. to 1s. 3½d.; 90/190%, 11d. to 1s. 2d.

NAPHTHALENE.—Crude, whizzed or hot pressed, £14 10s. per ton; purified crystals, £18 to £19 per ton in 2-cwt. bags. LONDON: Fire lighter quality, £3 to £3 10s.; 74/76 quality, £4 to £4 10s; 76/78 quality, £5 10s. to £6. SCOTLAND: 40s. to 50s.; whizzed, 70s. to 75s.

PYRIDINE.—90/140%, 5s. 3d. to 8s. per gal.; 90/180, 2s. 3d.

TOLUOL.—90%, 2s. 3d. to 2s. 4d. per gal.; pure, 2s. 6d. to 2s. 7d.

XYLOL.—Commercial, 2s. 4d. per gal.; pure, 2s. 6d.

PITCH.—Medium, soft, 43s. to 45s. per ton, in bulk at makers' works. MANCHESTER: 42s. 6d. to 45s. f.o.b., East Coast.

Intermediates and Dyes

ACID, BENZOIC, 1914 B.P. (ex Toluol).—1s. 9½d. per lb.

ACID, GAMMA.—Spot, 4s. per lb. 100% d/d buyer's works.

ACID, H.—Spot, 2s. 4½d. per lb. 100% d/d buyer's works.

ACID NAPHTHIONIC.—1s. 8d. per lb.

ACID, NEVILLE AND WINTHER.—Spot, 3s. per lb. 100%.

ACID, SULPHANILIC.—Spot, 8d. per lb. 100%, d/d buyer's works.

ANILINE OIL.—Spot, 8d. per lb., drums extra, d/d buyer's works.

ANILINE SALTS.—Spot, 8d. per lb. d/d buyer's works, casks free.

BENZALDEHYDE.—Spot, 1s. 8d. per lb., packages extra.

BENZIDINE BASE.—Spot, 2s. 5d. per lb., 100% d/d buyer's works.

BENZIDINE HCL.—2s. 5d. per lb.

p-CRESOL 34-5° C.—1s. 9d. per lb. in ton lots.

m-CRESOL 98/100%.—1s. 11d. per lb. in ton lots.

DICHLORANILINE.—1s. 11½d. to 2s. 3d. per lb.

DIMETHYLANILINE.—Spot, 1s. 6d. per lb., package extra.

DINITROBENZENE.—8d. per lb.

DINITROTOLUENE.—48/50° C., 9d. per lb.; 66/68° C., 10½d.

DINITROCHLORBENZENE, SOLID.—£72 per ton.

DIPHENYLAMINE.—Spot, 2s. per lb., d/d buyer's works.

α-NAPHTHOL.—Spot, 2s. 4d. per lb., d/d buyer's works.

β-NAPHTHOL.—Spot, £78 15s. per ton, in paper bags.

α-NAPHTHYLAMINE.—Spot, 11½d. per ton., d/d buyer's works.

β-NAPHTHYLAMINE.—Spot, 2s. 9d. per lb., d/d buyer's works.

o-NITRANILINE.—3s. 11d. per lb.

m-NITRANILINE.—Spot, 2s. 7d. per lb., d/d buyer's works.

p-NITRANILINE.—Spot, 1s. 8d. per lb., d/d buyer's works.

NITROBENZENE.—Spot, 4½d. to 5d. per lb.; 5-cwt. lots, drums extra.

NITRONAPHTHALENE.—9d. per lb.; P.G., 1s. 0½d. per lb.

SODIUM NAPHTHIONATE.—Spot, 1s. 9d. per lb.

o-TOLUIDINE.—9½d. to 11d. per lb.

p-TOLUIDINE.—1s. 11d. per lb.

Nitrogen Fertilisers

SULPHATE OF AMMONIA.—The prices have been announced for the remainder of the fertiliser year 1935/36 as follows: February, £7 3s. 6d. per ton; March to June, £7 5s., for neutral quality basis 20.6% nitrogen delivered in 6-ton lots to former's nearest station.

CALCIUM CYANAMIDE.—Prices for the remainder of the fertiliser year 1935/36 are: February, £7 2s. 6d. per ton; March, £7 3s. 9d.; April/June, £7 5s., delivered in 4-ton lots.

NITRO-CHALK.—The price for the 1935/36 season is £7 5s. per ton delivered in 6-ton lots to farmer's nearest station—all terms and conditions the same as for the season 1934/35.

NITRATE OF SODA.—The price for the 1935/36 season is £7 12s. 6d. per ton delivered in 6-ton lots to farmer's nearest station—all terms and conditions the same as for the season 1934/35.

CONCENTRATED COMPLETE FERTILISERS.—£10 10s. to £10 19s. per ton according to analysis, delivered in 6-ton lots to farmer's nearest station.

AMMONIUM PHOSPHATE (N.P.) FERTILISERS.—£10 5s. to £13 15s. per ton according to anlysis, delivered in 6-ton lots to farmer's nearest station.

Wood Distillation Products

ACETATE OF LIME.—Brown, £7 15s. to £8 15s. per ton; grey, £10 10s. to £11. Liquor, brown, 30° Tw., 8d. per gal. MANCHESTER: Brown, £9 10s.; grey, £11.

CHARCOAL.—£4 15s. to £10 per ton, according to grade and locality.

METHYL ACETONE.—40-50%, £43 to £46 per ton.

WOOD CREOSOTE.—Unrefined, 3d. to 1s. 3d. per gal.

WOOD NAPHTHA, MISCIBLE.—2s. 6d. to 3s. 6d. per gal.; solvent, 3s. 3d. to 4s. 3d. per gal.

WOOD TAR.—£2 to £2 10s. per ton.

Latest Oil Prices

LONDON, Feb. 5.—LINSEED OIL was quiet. Spot, £28 15s. (small quantities); Feb., £26 2s. 6d.; March-April, £26 5s.; May-Aug., £26 10s.; Sept.-Dec., £26 12s. 6d., naked. SOYA BEAN OIL was slow. Oriental (bulk), Feb. shipment, £21 5s. RAPE OIL was inactive. Crude extracted, £35; technical, refined, £36 10s., naked, ex wharf. COTTON OIL was quiet. Egyptian, crude, £25 10s.; refined common edible, £29; deodorised, £31, naked, ex mill (small lots £1 10s. extra). TURPENTINE was unchanged. American spot, 44s. 3d. per cwt.

HULL.—LINSEED OIL.—Spot, quoted £26 17s. 6d. per ton; Feb. and March-April, £26 10s.; May-Aug., £26 12s. 6d.; Sept.-Dec., £26 17s. 6d. COTTON OIL.—Egyptian, crude, spot, £25 10s. per ton; edible, refined, spot, £28 10s.; technical, spot, £28 10s.; deodorised, £30 10s., naked. PALM KERNEL OIL.—Crude, f.m.q., spot, £26 per ton, naked. GROUNDNUT OIL.—Extracted, spot, £31 per ton; deodorised, £34. RAPE OIL.—Extracted, spot, £34; refined, £35 10s. SOYA OIL.—Extracted, spot, £27 per ton; deodorised, £30. COD OIL.—F.o.r. or f.a.s., 25s. per cwt., in barrels. CASTOR OIL.—Pharmaceutical, 42s. 6d. per cwt.; first, 37s. 6d.; second, 35s. 6d. TURPENTINE.—American, spot, 45s. per cwt.

Books Received

Official Publications Received

The Action of Hydrogen Upon Coal. Part II.—Early Experiments with the Bergius Process. Fuel Research Technical Paper No. 42. London: H.M. Stationery Office. Pp. 58. 1s. 3d.

Flame. By O. C. de C. Ellis and W. A. Kirby. London: Methuen and Co., Ltd. Pp. 106. 3s.

Imperial Institute. Annual Report 1935, by the Director, Sir Harry Lindsay, to the Board of Governors. London: Imperial Institute. Pp. 58.

From Week to Week

NEWARK TOWN COUNCIL has resolved to renew its contract with the Staveley Coal and Iron Co. for the sale of sulphuric acid for a period of 12 months, on the same terms as before.

NORMAN HILL BROS., LTD., 114 Victoria Road, North Acton, N.W.10, have increased their nominal capital by the addition of £2,600 in £1 ordinary shares beyond the registered capital of £400.

ACCORDING TO AN OFFICIAL RETURN which has just been published there are thirty-seven registered companies in the Irish Free State engaged in the manufacture of chemicals. The total of their nominal share capital is £621,400.

PUBLIC SITTINGS of the Royal Commission on Safety in Coal Mines will be held next Monday and Tuesday, when evidence will be taken from the Mines Department. The sittings will be at Montague House, Whitehall, and will begin at 11 a.m. on the Monday and at 10.30 a.m. on the Tuesday.

THOMAS HEDLEY AND CO., LTD., soap manufacturers, Newcastle, have adopted the forty-four hours' week for its workers who have hitherto worked forty-eight hours. In 1934, this company, which is controlled by the Procter and Gamble Co., Cincinnati, U.S.A., opened a new factory at Trafford Park, Manchester. It has now been found necessary to plan a new factory to cope with increased sales, and steps are being taken to double the capacity of the Manchester works.

A SPECIAL SITTING of Irvine Dean of Guild Court on January 29 passed plans of a factory for the manufacture of incendiary bombs, signal grenades, etc., to be constructed at an estimated cost of £4,200 by Nobels Explosives Co. at the site of the old Kyle chemical factory in Gailes Road, Irvine. The plans provide for the alteration of existing buildings and the erection of 14 new buildings. The work is to be carried out on ground adjacent to a similar factory for Nobels, constructional work on which was started a few weeks ago.

THE TREASURY, on the recommendation of the Import Duties Advisory Committee, has made an order exempting oxalic acid from import duty from February 2. It is one of the materials used by a section of the textile industry and by allied industries, and it has for some time been exempt from key industry duty and chargeable with the general *ad valorem* duty of 10 per cent. imposed by the Import Duties Act. The committee states that it has hitherto refrained from recommending its addition to the free list because of indications that commercial production of the acid in this country was imminent, but it now understands that it is still uncertain when suitable supplies will be available.

A GREAT CZECHOSLOVAKIAN CHEMICAL TRUST has been formed by the completion of a merger between the Aussiger Chemical Union and the Czechoslovakian Explosives A.G. "Explosia." "Explosia" was founded in 1920 as part of the Nobel Dynamite concern, but in 1931 "Explosia" broke away and became an independent organisation. A considerable proportion of its share capital is held in England. The Aussiger concern has a controlling interest in the Olderberg Chemical Works, the Bohemian Explosive Factory and the Koliner Chemical Factory, together with the Solo Match Works. The share capital of Aussig is to be raised from Kr.50,000,000 to Kr.75,000,000.

MAGNESIUM CARBONATE prepared by a process developed at the Physical and Chemical Research Institute is to be produced at Kashiwasaki, Niigata Prefecture. The plant will start with a capacity of 10 metric tons daily, to be increased to 15 tons daily. It is financed by a new firm capitalised at 3,000,000 yen, owned by the Institute and the supplier of magnesite. Magnesite from Korea and Manchuria will be calcined to yield carbon dioxide and magnesium oxide. The magnesium oxide is powdered and dissolved in water to yield magnesium hydroxide, which reacts with carbon dioxide to form magnesium bicarbonate. The bicarbonate is subjected to a continuous charge of steam, and forms crystallised carbonate. The product is dried and powdered for shipment. Chief outlets for magnesium carbonate in Japan are in the manufacture of rubber goods, dentifrices and pharmaceutical products.

THE FIRST TEST DRILLING for British oil, following the granting of oil prospecting licences by the Board of Trade, is likely to begin next month at Paulsgrove, near Portsmouth. The D'Arcy Exploration Co., a subsidiary, wholly owned, of the Anglo-Iranian Oil Co. has started to erect a combination drilling rig. A special road has also been constructed. Experts from the company's drilling staff, many of them with experience in Iran, will be in charge of operations. Test drilling will also be started soon in Sussex by the D'Arcy Exploration Co. It is understood that the company, which has been granted 39 licences by the Board of Trade, may begin drilling this year in other parts of Southern England. Hampshire, Dorset, and Wiltshire are possible sites. Recently Mr. F. J. Wolfe, chairman of the Anglo-American Oil Co., said that his company would not be lacking in "the active search for crude oil" in this country.

THE TREASURY has made an Order under Section 10 (5) of the Finance Act, 1926, exempting safrol from Key Industry Duty from February 12 until August 19.

THE IMPORT DUTIES ADVISORY COMMITTEE has received applications for an increase in the rate of drawback in respect of certain grades of linseed oil. The committee also has under consideration the rates of import duty applicable to vitreous enamels and frits. Representations should be addressed in writing to the Secretary, Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, Westminster, London, S.W.1, not later than February 20 in the case of linseed oil, and not later than February 27 in the case of the other commodities.

THE METAL BOX CO., LTD., has acquired the tin canister section of F. Robinson and Co., Ltd., of Hull. This business will be operated under the name of the Metal Box Co., Ltd., Robinson Branch, with Mr. F. Guy Robinson in charge, but there will be no change in policy. The keg and drum section of the business will remain in the ownership of F. Robinson and Co., Ltd., and will be housed in a new factory to be constructed. F. Robinson and Co., Ltd., is a private company.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

Austria.—An agent established at Vienna wishes to obtain the representation, on a commission basis, of United Kingdom manufacturers of aniline colours for the textile industry. (Ref. No. 92.)

Austria.—An agent established at Vienna wishes to obtain the representation, on a commission basis, of United Kingdom manufacturers of chemicals for industry and trade. (Ref. No. 93.)

Belgium (Provinces of Liége and Luxemburg or other provinces if desired).—An agent established at Liége wishes to obtain the representation, on a commission or other agreed basis, of United Kingdom manufacturers of pharmaceutical products. (Ref. No. 95.)

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

(NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt as specified in the last available Annual Summary, is also given marked with an *—followed by the date of the Summary, but such total may have been reduced.)

DURION, LTD., London, S.W., electro-chemical engineers, etc. (M., 8/2/36.) Registered January 27, £500 debentures, part of £3,000 (not exceeding) already registered.

E. AND D. H. RICHARDS, LTD., Oswestry, fertiliser manufacturers. (M., 8/2/36). Registered January 24, £550 debentures; general charge.

LEEDS CHEMICAL CLEANING WORKS, LTD. (M., 8/2/36.) Registered January 27, mortgage, to Midland Bank, Ltd., securing all moneys due or to become due to the Bank; charged on 1 Stonegate, York, etc. *Nil. July 5, 1934.

McCLURE YOUNG AND CO., LTD., London, N.W., manufacturers of disinfectants, etc. (M., 8/2/36.) Registered January 24, debenture, to Lloyds Bank, Ltd., securing all moneys due or to become due to the Bank; general charge. *£5,439. December 31, 1934.

VACUUM DRIER AND CHEMICAL EQUIPMENT CO., LTD., London, S.W. (M., 8/2/36.) Registered January 25, debenture securing £111 19s. 9d. and further sums not exceeding a total of £1,000, to Mirrlees Bickerton and Day, Ltd., Hazel Grove; general charge.

Forthcoming Events

LONDON

Feb. 10.—Institution of the Rubber Industry. "Rubber in Quarrying." H. C. Young. 7.30 p.m. 12 St. James's Square, London, S.W.1.

Feb. 11.—The Pharmaceutical Society of Great Britain. "Chemical and Pharmacological Aspects of the Hormones." Professor E. C. Dodds. 8.30 p.m. 17 Bloomsbury Square, London, W.C.1.

Feb. 11.—British Association of Refrigeration. Informal Meeting. British Industries House, Marble Arch, London.

Feb. 11.—The Institution of Petroleum Technologists. Symposium of papers on Welding in the Petroleum Industry. "Welding in Field and Drilling Equipment." J. Cuthill; "Welding of Pressure Vessels." Eng. Lt.-Commdr. S. F. Dorey; "Welding in the Transportation and Storage of Petroleum Products," A. C. Hartley and A. C. Vivian; "The Training of Welders," R. T. Rolfe and W. G. Poole. 5.30 p.m. John Street, Adelphi, London.

Feb. 12.—The Chemical Society. Sixteenth Faraday Lecture. "Radioactivity and Atomic Theory." Lord Rutherford of Nelson. 5.30 p.m. Lecture Theatre of the Royal Institution, Albemarle Street, London.

Feb. 12.—Electrodepositors' Technical Society. "The Colouring of Metals." J. W. Perring; "The Lacquering of Metals." R. Holloway. 8.15 p.m. Northampton Polytechnic Institute, St. John Street, Clerkenwell, London.

Feb. 13.—The Institute of Vitreous Enamellers (Southern Section). "Town's Gas for Vitreous Enamelling." W. Dieterichs. 8 p.m. British Industries House, Marble Arch, London.

Feb. 13.—Institute of Fuel (London Section). "The Co-ordination of Fuel and Power Supplies of Great Britain." O. W. Roskill. 6 p.m. Burlington House, Piccadilly, London.

Feb. 14.—Institute of Fuel. "The Economic and National Aspects of the Production of Oil from Coal." Discussion opened by Professor W. A. Bone. 7 p.m. British Industries House, Marble Arch, London.

Feb. 14.—Chemical Engineering Group. "Some Aspects of Chemical Works Pumping and Acid Handling." E. A. Reavell. 8 p.m. Burlington House, Piccadilly, London.

CARDIFF

Feb. 14.—Society of Chemical Industry (South Wales Section). "Flocculation." J. O. Samuel. 7.30 p.m. Cardiff.

BIRMINGHAM

Feb. 12.—British Cast Iron Research Association. "The Phase Rule Applied to Metals and Alloys." Major F. A. Freeth. 2.30 p.m. James Watt Memorial Institute, 37a Great Charles Street, Birmingham.

GLASGOW

Feb. 10.—Institute of Metals (Scottish Section). "Corrosion of Metals by Industrial Waters." F. Hudson. 7.30 p.m. 39 Elmbank Crescent, Glasgow.

LIVERPOOL

Feb. 13.—Institute of Chemistry (Liverpool Section). "From Boyle to Priestley." R. B. Pilcher. 7.30 p.m. Constitutional Club, India Buildings, Water Street, Liverpool.

MANCHESTER

Feb. 14.—Oil and Colour Chemists' Association. Discussion on Current Theories with regard to the Polymerisation of Drying Oils. Opened by Professor T. P. Hilditch. Colelge of Technology, Manchester.

NEWCASTLE-ON-TYNE

Feb. 11.—Institute of Metals (North-East Coast Local Section). "Some Recent Developments in the Improvement of Non-Ferrous Alloys by Heat-Treatment." W. T. Griffiths. 7.30 p.m. Armstrong College, Newcastle-on-Tyne.

SHEFFIELD

Feb. 14.—Institute of Metals (Sheffield Local Section). "Engine-turning and Enamelling." R. S. Hill. 7.30 p.m. University, St. George's Square, Sheffield.

STOKE-ON-TRENT

Feb. 10.—The Ceramic Society (Pottery Section). "Mechanical Handling." P. C. Bleakman. 7.30 p.m. North Staffordshire Technical College, Stoke-on-Trent.

SWANSEA

Feb. 11.—Institute of Metals (Swansea Local Section). "Some Modern Developments in Stainless Steels." J. H. G. Monypenny. 6.30 p.m. Y.M.C.A., Swansea.

New Companies Registered

Allens Chemists, Ltd., 186 Bishopsgate, E.C.2.—Registered January 27. Nominal capital £500. Manufacturers of and dealers in chemicals, gases, drugs, medicines, etc. Directors: J. Bordoley, A. Bordoley.

British Ceraline, Ltd., 12 Park Street, Lytham, Lytham-St.-Annes.—Registered January 25. Nominal capital £3,000. To acquire the business of manufacturers, refiners and distillers of wool grease, lanoline, wool grease fatty acids and their preparations carried on by J. W. Knowles and T. Knowles at Birksland Works, Birkshall Lane, Bradford, as "British Ceraline Company. Directors: J. W. Knowles, T. Knowles.

Charcoal and Chemical Products Co., Ltd., 14 Gray's Inn Square, W.C.1.—Registered January 27. Nominal capital £10,000. Chemists, manufacturers of and dealers in chemical and pharmaceutical products, charcoal, active carbons, fertilizing, filtering and similar materials, etc. A subscriber: H. G. Read.

Delta Processed Oil Products, Ltd., 1 Albemarle Street, W.1.—Registered January 17. Nominal capital £100. Importers, distributors, distillers, blenders, refiners and sellers of and dealers in oil products of all kinds, including lubricating oils and greases and other lubricants, motor spirit, crude oil, oil substances, methylated and petroleum spirits, chemicals, etc. Directors: M. C. D. Cunha, J. H. Robertson.

Fuel Improvement Co., Ltd., 6 Old Jewry, E.C.2.—Registered January 20. Nominal capital £10,000. To acquire any coal, iron, ironstone or other minerals or mineral substances or any collieries, mines, mining rights, privileges or easements in any part of the world; and to carry on the business of colliery proprietors, manufacturers of and dealers in patent fuel, briquettes, binder for briquettes, boulets, ovoids, compressed fuels, synthetic products, petrol, petroleum, benzine and all oils, gasophalt, and all by-products of coal, metals and mineral substances of all kinds, etc. Subscribers: Bernard J. Weaver and Leonard J. Huggett.

L. Le Personne & Co., 7 Old Bailey, E.C.4.—Registered January 18. Nominal capital £100,000. The objects are to acquire the business of merchants, dealers, factors, agents, brokers and manufacturers carried on by L. Le Personne and Co., at 7 Old Bailey, E.C., and to carry on the same and the business of dealers in raw and manufactured ferrous and non-ferrous metals, glass, tiles, chemicals, mineral earths, ores, products, firearms, and ammunition, etc. Directors: L. A. G. Le Personne, A. W. Watson, Wm. G. Mereweather.

Nichrotan, Ltd., 7 Osborn Place, Whitechapel, E.1.—Registered January 23. Nominal capital £1,500. To adopt an agreement with Fini G. A. Enna (the vendor) for the acquisition of a secret process or formula for the manufacture of Nichrotan, together with the goodwill of the business of a manufacturer of Nichrotan carried on by the vendor, and the benefit of the trade mark, and to carry on the business of importers, exporters and manufacturers of and dealers in chemicals, tanning and similar and other processes and preparations, etc. Directors: L. D. Womersley, G. P. Chamen, G. D. Sheppard, E. N. Sheppard.

Renal Laboratories, Ltd., 82 Bunhill Row, E.C.1.—Registered February 1. Nominal capital £100. Chemists, druggists, chemical manufacturers and dealers, etc. A subscriber: E. A. Cook.

Thamesmouth Rubber Co., Ltd.—Registered January 20. Nominal capital £5,000. To acquire from Commercial Rubber Products, Ltd., at Southend-on-Sea, freehold premises, plant, and machinery, and to carry on the business of manufacturers and repairers of, agents for and dealers in rubber, balata and gutta percha, surgical, hygienic and medical goods, rubber goods, etc. Directors: Wm. J. Clitter, Tudor House, Thorpe Hall Avenue, Thorpe Bay, and Sidney M. Derrick.

Zems, Ltd., 32 Watling Street, E.C.4.—Registered January 22. Nominal capital £1,500. To adopt an agreement with David Gold, trading as Zems, of 113 Park Avenue, N.W.10 (including the registered trade mark "Zems"), and to carry on the business of manufacturing chemists, manufacturers, importers and producers of and dealers in all kinds of salts, acids, alkalis, drugs, etc. Directors: D. Gold, L. Walters, P. Hoffman-Swedlow, H. Walters.

Company News

Doulton and Co.—The dividend on 5 per cent. preference stock for the year ended December 31, 1934, is announced, payable on February 18. The directors hope, after completion of the accounts for the year ended December 31, 1935, to authorise payment of the dividend for that year on April 1.

The International Nickel Co. of Canada.—A quarterly dividend of 25 cents is announced, the same as for the previous quarter. In the March quarter of last year the dividend was 15 cents, followed in June by another 15 cents, and in September by 20 cents. The total for 1935 was therefore 75 cents per share of common stock, compared with 50 cents in 1934. In the two preceding years, 1932 and 1933, no dividends were paid.

English Velvet and Cord Dyers' Association.—The directors have decided to pass the dividend on the 5 per cent. preference shares for 1935, and to make no distribution on the ordinary shares. In June it was announced that consideration of dividend for the half-year on the preference and ordinary shares would be deferred until the full year's results had been ascertained. The preference dividend was paid in full in the previous year. No ordinary payment has been made since 1931, when shareholders received 4 per cent.

Gas Light and Coke Co.—The report for 1935 states that sales of gas have risen from £8,331,051 to £8,403,295, and those of residual products are up from £1,974,141 to £2,119,280. Revenue from rentals has jumped by £69,586 to the record figure of £1,661,922. Gross revenue totals £12,236,808, against £11,949,482. Expenses have increased from £9,923,366 to £10,165,570, the balance carried to net revenue account showing an advance of £45,121 at £2,071,237. The dividend on the ordinary stock is maintained at the usual level of 5 3/5ths per cent., and the carry-forward is raised from £183,068 to £202,624.

Broken Hill South, Ltd.—A dividend of 2s. 6d. (12½ per cent.) and a Jubilee bonus of 2s. 6d. per share have been declared payable in Melbourne on March 14. In March, 1935, the dividend was 7½ per cent. The Jubilee bonus, which marks the fact that the south mine has been worked for fifty years, was foreshadowed in November last.

The British Oxygen Co., Ltd.—With a view to commemorating its fiftieth anniversary the directors have decided to recommend to the shareholders the capitalisation of part of the reserves by the free distribution of two fully-paid bonus ordinary shares of £1 each for every £7 ordinary stock held. A bonus issue to celebrate the anniversary was foreshadowed by the chairman at an extraordinary meeting held in July last to increase the capital.

Fairy Dyes.—The report for the year ended November 30, 1935, states that profits, including interest and transfer fees received, amounted to £8,302 (against £8,213), to this is added balance brought forward £813, making £9,115. After deducting dividend on preference shares for the half-year to June 1, 1935, £1,350, and directors' and auditors' fees and income-tax £960, leaving £6,805. Dividend on preference shares for the half-year to December 1, 1935, absorbed £1,350, and it is proposed to pay dividend of 7½ per cent. on the ordinary shares, £4,800, leaving £655 to be carried forward.

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